Food Futures and Food Security by 2010 A.D.

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- A Draft Document -

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PREAMBLE

Inspite of the spectacular increase in production of foodgrains during the last 15 years, the stagnation in growth of production of pulses and oilseeds is the most disquietening feature of the Indian food sector. Besides the recent draught situation has given us the proof that there is no evidence as yet that increasing trend with respect to other foodgrains as noticed between 1980 and 1985 will be maintained because a large proportion of foodgrains continued to be produced under uncertain conditions with more than 70% still being rainfed. Besides the concentration of the achievement of green revolution in few regions is indicated by the fact that 15% of the total cultivated area under foodgrains contributed as much as 56% of the increased production. Even in terms of different food crops, cropwise disparities in growth is noticed between foodgrains. This has created an imbalance between supply and demand for different food crops as noticed specially with oilseeds and other pulses.

In view of this it was felt necessary to study the food futures by next 25 years. A project was initiated by the Department of Science and Technology, Ministry of Science and Technology, Government of India entitled "**A Study Of Food Futures And Food Security By 2010 A.D.**" for six months and taken up by Central Food Technological Research Institute, Mysore - 570 013.

A base draft document has been prepared to discuss the future food challenges and the role of food security by 2010 A.D. based on demand and supply projections using suitable growth models. Since

cereals, pulses and oilseeds together constitute more than 80% of the total calories of the Indian population presently, the above three raw materials have been taken up for the study. The document will be used as a base material to initiate and spark discussion by the experts invited for the Workshop and the conclusions and recommendations drawn during the Workshop will hopefully form as a reference material for the food policymakers for planning suitable food policy decisions for the next 25 years.

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1. INTRODUCTION

India with its regional diversity and vast land mass, coupled with the triple advantages of water, soil and sunshine has enviable possibilities of growing a variety of crops economically. Agriculture occupies a key position in Indian economy because of its contribution to overall economic growth and a main occupation for about 75% of the population. India is the second most populous country in the world and more food has to be produced not only to satisfy the hunger of the millions but also to meet the nutritional requirements for maintaining and improving health standards.

Providing for an average population growth of 2% annually, the food production will have to be increased at a much faster rate both to meet the basic needs as well as to provide sufficient cushioning for seeds, post harvest losses, buffer stocking and export compulsion. Food grains command 73-78% of the gross cropped area which is around 115 million hectares and the share has remained more or less unchanged since the year 1950. However, as the total area under food grains has tended to stabilise, the total gross area has continued to increase due to the expansion of double and multiple cropping.

The last two decades have witnessed a green revolution in India's foodgrain sector. In the mid 60's our food economy was in severe crisis and the country was heavily dependent on imports of wheat which were financed primarily through the P.L.480 Food Assistance Programme. Since then the situation gradually improved and impressive strides in foodgrains output have been brought about by a combination of huge investments in irrigation, introduction of high yielding grain

varieties and increases in farm prices. In addition to its efforts to increase food grain output, the Government tries to ensure the availability of foodgrains to low income consumers at subsidised prices.

The production of foodgrains nearly tripled from 50.8 million tonnes in 1950-51 to 152.4 million tonnes during the year 1983-84, and the estimate for 1986-87 is around 150 million tonnes inspite of drought situation. The growth rate was estimated at 61.4% during the years 1950-51 to 1960-61; 32.5% between 1960-61 and 1970-71; 19.5% between the period 1970-71 and 1980-81 and 16.1% during the period 1980-81 to 1985-86 respectively.

The population of the country has increased enormously from 420 million in 1950-51 to 761 million by the year 1986. The rate of growth was around 2% per annum and many more millions are added to the country's population every year. The population is expected to touch 970 million by the year 2000 A.D. and it is projected that it may reach 1150 million by the year 2010 A.D. To meet the food requirements, we have to gear up our production of foodgrains by adopting new agricultural techniques. Food is of primary importance because it is the basis of life, vital for all body functioning and grains constitute a major component of daily diet. As per the recommendations of task force of nutrition, a normal adult requires 2124 calories, 46g of proteins, 16-28g of fat and a host of micronutrients like minerals, vitamins, essential amino acids and fatty acids at certain minimum levels. This requirement may vary depending on the physiological and environmental conditions. Over the years revolutionary changes have come about in our ideas about food. It is no longer considered as

something one consumes merely to satisfy hunger but also plays a major role in maintaining and improving human health and happiness.

Population profile and food needs :

For a population of 765 million, the country produced 142 million tonnes of cereals, 13 million tonnes of pulses and 13 million tonnes of oilseeds from a cultivated area of 150 million hectares. At these levels of production the gross per capita availability of food per day works out to 450 g of cereals, 40 g of pulses and 43 g of oilseeds as against recommended levels of 435 g, 60 g and 56 g respectively.

This indicates a significant supply gap for pulses and oilseeds oils in the country. According to realistic projections, the population of our country is expected to touch 1150 million by the year 2010 A.D. and to meet the basic food needs of a population of this dimension, we have to accelerate our production to reach at least 202 million tonnes of cereals, 24.2 million tonnes of pulses and 23.7 million tonnes of oilseeds. According to Dr. M.S. Swaminathan "there is a huge gap between actual yields of various crops on the farmer fields and the potential in most farming systems in the country". Systematic assessment of food production potential in the country has brought out the fact that we are endowed with a large untapped production reservoir. Demonstrations and production trials laid out under farmer's fields under All India Coordinated project on National Demonstrations and the All India Coordinated Agronomic Experiments are reported to have revealed that vast potentials exist in most states for improving the present levels of productivity.

Even at the currently available levels of technology, the yields are capable of being increased by 2 - times on an average. It is not considered beyond our capability to achieve increased production through better management of water resources, more efficient soil management, rational changes in cropping pattern, better input management, easy availability of energy, effectiveextension, remunerative prices for the produce and support policy measures. Under these circumstances, challenge of food needs will be multiplied by 2010 A.D. Suitable plans are to be formulated for mobilisation of adequate resources and faster execution of developmental programmes.

In view of the above situation, it is felt necessary to study the food outlook by 2010 A.D., covering not only the policy implications of projected demand and supply of food, but also from the angle of achieving the socio-economic objective of attaining expanded food security, which includes identification and application of appropriate technologies, which offers large and varied potentials to increase effective supplies and increase the adequacy of food consumption - effective supply by appropriate changes in production techniques and strategic improvement in productivity, reducing losses during storage, transport, processing or retailing and preparations - the adequacy of food consumption by bringing about changes in habits, traditions and attitudes regarding storage practices and food preparation methods resulting in reduction in loss and malnutrition.

This is expected ensure improvement in efficiency of food systems as a whole and finally contributing significantly to general economic development.

The above concepts have been used to serve as a broad basis for the present study which has attempted to

1) assess the total food requirement based on normative demand of food for different projected population by 2010 A.D.

2) estimate the supply possibilities under alternative scenarios using suitable projection models

3) study the possible gap existing between projected supply and demand for different food raw materials under alternative scenarios

4) redefining the role of food security based on the analysis of the future food scenario to meet the future food challenges

Since foodgrains and oilseeds constitutes over 80% of production and also form major components in the Indian diet, presently cereals, pulses and oilseeds have been taken up for the study.

PRESENT STATUS OF FOODGRAIN AND OILSEEDS PRODUCTION

In general, foodgrains constitute cereals, millets and pulses. The production of these commodities increased from 55 million tonnes in 1950-51 to 150 million tonnes during 1985-86. The corresponding production of oilseeds during these relative periods was around 5 and 13 million tonnes respectively (Table 1).

The compound annual growth with resect to area production and yield indicates between 1967-68 and 1985-86, the yield growth with respect to wheat was the highest (3.15% per annum) while as against the average yield of cereals of 2.21 percent. The compound growth of productivity with respect to pulses was hardly 0.2 percent per annum. Hence any improvement in productivity is mainly with respect to wheat (Table 7).

Cereals : Cereals are the principle food which meet the energy and nutrition needs of India's population. Cereals are broadly categorised into rice, wheat and coarse grains popularly called millets. During the pre-green revolution era, rice was the principal crop that formed the staple diet of majority of population. After the year 1970, wheat production showed a remarkable increase with a peak level of 48 million tonnes during 1985-86 as against 26 million tonnes during 1970, compared to 64 million tonnes of rice and 27 million tonnes of coarse cereals (Table 5).

RICE

The bulk of rice is grown during the Kharif season, especially in the traditional rice growing regions of A.P., Bihar, Tamilnadu and West Bengal. One of the recent developments in the rice economy of India is the emergence of Punjab, Haryana and to a limited extent Rajasthan and Uttar Pradesh as major producing states of rice. This cereal crop during the period 1967-68 to 1981-82 showed a compound rate of 17.7 percent in Punjab, 14.7 percent in Haryana and 9.8 in Uttar Pradesh.

Over the last three decades remarkable progress was witnessed in rice production technologies throughout the world. For example the average yield of rice in India is placed at 1568 kg per hectare. China, Japan and Republic of Korea have been able to achieve figures of 3534 kg, 6250 kg and 6551 kg respectively. Introduction of modern rice varieties, use of quality seeds and widespread adoption of new farming techniques have contributed to the spectacular progress in rice front.

In India, though rice production has increased from 22 million tonnes in 1950-51 to 64 million tonnes in 1985-86, drought, floods and water management practices reflect the year to year fluctuations in rice output and also production levels not proportionate to area under rice. Unlike in case of wheat, area under high yielding varieties has not increased much over the years. This is reflected in marginal change in the productivity per hectare from 1.12 tonnes to 1.57 tonnes between 1970-71 to 1985-86 (Table 6).

WHEAT

India ranks fourth among the top most wheat producing countries in the world. Wheat is the second most important crop in our country with a production of 47 million tonnes (1985-86) and comes only next to rice.

The wheat production which has stagnated at 10.5 million tonnes in 1965-66, leaped to peak level of 47 million tonnes during 1985-86 (Table 3). No other country has been able to achieve this kind of spectacular increase in wheat production as India. This became possible because of the new dwarf wheat technology developed by the agricultural scientists of ICAR which was successfully adopted, suiting the agro climatic requirements of our country.

Thus the green revolution was essentially a wheat revolution and wheat is virtually the only crop in which a real breakthrough in productivity has been achieved. The production registered a compound annual growth rate of over 3.15 per cent against 1.92 per cent in case of rice. (Table 3). Infact it was the wheat revolution which has been considered responsible for increased foodgrain production which has reached a level of more than 150 million tonnes. Another crucial effect of wheat revolution has been the growing popularity of this cereal in non-wheat consuming states.

The new technology, coupled with the policy of guaranteed minimum price has paid rich dividends in the case of wheat (Table 3). There has been considerable diversion of area to this crop and what is more, an increasingly higher proportion of the expanding area has been brought under high yielding variety (around 90% now) (Table 8).

But yet there are wide gaps between average productivity of wheat in different states and the yields realised by best farmers. Research scientists have evolved a variety which give 3.5 tonnes to 4 tonnes per hectare under well managed conditions. But the average yield per hectare in the country today is nothing more than 2 tonnes. This indicates that tremendous potential existing for increasing in the production of wheat in future years.

Theoretically yield can be maximised by exploiting three components :

1) maximising number of plant population per plot.
2) getting the larger number of grains per plant.
3) maximising grain size.

Gap in management precision, improper tillage and agronomic practices, soil health problems, faulty water management, poor harvest technology and inadequate plant protection are known to be mainly responsible for lower yields at farmers level than those noticed under research trials. Improper use of inputs, including fertiliser and irrigation and of course the climatic factors can also lower the yield.

The state policies regarding the pricing of agricultural inputs or produce need to be recast to ensure that good profits result from higher yields.

COARSE CEREALS

In comparison to rice and wheat, coarse cereals contribute an average 21 percent of the total foodgrain poduction in the country. Despite their superiority in terms of nutritional value like protein

and minerals over rice (Table 11), they are yet considered as inferior in terms of their economic and social status in the Agrarian economy. While reviewing the growth of production of coarse cereals during the last 35 years, it is noticed their share in total area under foodgrains has come down from 39 percent in 1951 to 31 percent in 1985 and production from 31 percent to 21 percent respectively (Table 4 & 5).

The major coarse grains constitute jowar, maize and bajra followed by ragi and small millets. The production of coarse cereals in absolute terms has however, increased from 16 million tonnes in 1950-51 to 31.2 million tonnes in 1985-86 despite the stagnation in total area. This substantiate that high yielding variety revolution has not totally bypassed coarse cereals (Table 8).

A disintegrated study of growth pattern of different coarse cereals reveal that the share of maize has increased from 12 percent to 28 percent between 1950-51 to 1985-86; while in case of jowar, only a marginal increase is noticed during the same period. Bajra production has almost remained stagnant. The small millets and other coarse cereals have shown a decline from 27 percent to 16 percent respectively during the same period.

The proportionate of irrigated area has shown a marginal increase case of bajra while it has increased from 14 percent to 21 percent in case of maize. Even the area under high yielding varieties has increased from a mere 7.8 percent to 35.5 percent between 1971-72 to 1985-86 in case of maize.

The above analysis presents a better performance in case of

maize in terms of responsiveness to irrigation and high yielding varieties. This indicates the potential of maize as a future crop (Table 14a).

Table 13

Composition Of Coarse Cereals Production

Share of	Triennial averages centred around (in percentage)					
	1950-51	1960-61	1970-71	1980-81	1984-85	1985-86
Jowar	36	38	31	39	36	40
Bajra	16	15	23	17	20	16
Ragi	9	8	8	9	8	8
Maize	12	18	22	22	27	28
Others	27	21	16	13	9	8
	100	100	100	100	100	100

Source : Economic & Political Weekly, vol.xxi, No.38 & 39

Table 14

Proportion Of HYV And Irrigated Area Under Crops

	Proportion of HYV Area			Proportion of Irrigated Area		
	1971-72	1980-81	1984-85	1971-72	1980-81	1982-83
Coarse cereals:						
Jowar	4.1	22.1	32.4	4.4	3.8	3.7
Bajra	15.0	31.2	49.3	3.7	5.4	6.0
Maize	7.8	26.3	35.5	14.3	19.7	21.3
Superior cereals:						
Rice	19.6	45.4	56.9	37.2	40.5	41.9
Wheat	41.1	72.3	82.9	54.5	69.7	72.4

Table 15

Proximate Composition of Coarse Cereals Vis-a-Vis Other Cereals/Pulses

Foodgrains	Energy KCal	Protein gm	Minerals gm
Rice - raw milled	345	6.8	0.6
Wheat - whole	346	11.8	1.5
Jowar	349	10.4	1.6
Bajra	361	11.6	2.3
Maize - dry	342	11.1	1.5
Ragi	328	7.3	2.7
Bengal gram (dhal)	372	20.8	2.7
Red gram (dhal)	335	22.3	3.5
Black gram (dhal)	347	24.0	3.2
Green gram (dhal)	348	24.5	3.5

Source : Economic and Political Weekly, Vol.xxi, No.38 & 39

The main constraint with respect to expansion of production of coarse cereals are the lower responsiveness to availability of more favourable conditions of higher rain fall or irrigation atleast under available technology. Their advantage however, is their stability and draught resistance compared to rice under adverse climatic conditions.

PULSES

India accounts for the largest area (35%) as well as production (25%) of pulses in the world. However, the productivity has remained quite low as compared to the other pulse growing countries. There has been a virtual stagnation in the pulse output over the last 15 years. (Table 4). The low level of production coupled with ever-increasing population has resulted in a decrease in per capita availability of pulses declined from 69 gm per day in 1951 to 38 gm per day in 1985 against a minimum requirement of 50 gm per day, recommended by the nutritional experts. To fill up the gap in per capita availability and

achieve reasonable nutritional standard, the growth rate of production of pulses will have to be around 20% per annum for the next 10 years which might not appear to be within the range of practical achievements. The overwidening gap between supply and demand of pulses in the country has resulted in a sharp rise in their prices which affects consumption adversely, specially among the rural poor. Consequently either they have to forego pulses in their diet or consume inadequately.

The pulses are grown in three crop seasons viz., Rabi, Kharif and Zaid in the country. The main pulses grown are gram and arhar which share over 50 percent of the total pulses production. The other important pulses are urd, mung, horsegram and lentil. The share of different pulses with respect to area and production is presented in the following table.

Table 16

Area And Production Of Different Pulses

Name of the pulse	Percentage contribution		Productivity (Kg/hectare)
	Area	Production	
Gram	30.17	37.28	663
Arhar	24.13	21.86	830
Urd	13.23	9.70	394
Mung	13.05	9.80	403
Moth	5.92	2.10	191
Lentil	4.69	4.46	510
Fieldpea	1.96	2.76	757
Cowpea	4.35	3.00	569
Lathyrus	5.02	4.06	452

It is noticed from the above table, lathyrus also form an important pulse in our economy, despite it being considered as not

suitable for human consumption.

The trend in area production and productivity of individual pulses show that mung production has doubled between 1964-65 to 1985-86 mainly due to increase in productivity. However, in case of arhar the increase in production is mainly due to increase in area though marginal increase in productivity is also indicated. The increase in area under arhar is mainly because of the introduction of short duration varieties in non traditional areas of the North Western parts of the country. In case of mung, the increase in area is mainly in the irrigated belt of northern area as a summer crop and in the peninsular and southern Indian as winter crops in the rice fallows. The popularity of the short duration variety has resulted in the increase in area with respect to this crop.

There has been a virtual decline with respect to other pulses during the same period both with respect to area and production. A comparative performance of potential pulse yield obtained on demonstration fields in relation to yield obtained on farmer's fields in different states has shown that there is a wide gap between the potential and actual yields (Table 16).

Wide performance gap between potential and average yields of states indicates the extent of potential of crop yield that is yet to be tapped. Most of the states have not achieved the national average figure of potential yield. However, very few states have shown good performance in respet of productivity of a particular crop, but the area under pulses in such states is quite less, where the performance gap is minimum, the area under pulses in such states may be increased

to obtain higher level of production.

The low productivity of pulses in India may be due to low share of irrigated area to total area under pulses. Pulses are generaly cultivated in marginal and low soil fertility under rainfed and dry land condition with very low levels of inputs.

Table 17

Area, Production And Productivity Of Individual Pulses Since 1964-65

Pulse	1964-65 to 68-68			1974-75 to 78-79			1985-86		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
Gram	8.0	4.78	594	7.89	5.23	675	7.65	5.68	742
Arhar	2.57	1.66	646	2.50	1.89	725	3.20	2.43	756
Mung	1.87	0.55	294	2.48	0.80	322	2.84	1.09	384
Urd	1.84	0.55	299	2.21	0.74	332	3.07	1.20	390
Other Pulses	8.20	3.10	318	7.11	3.02	425	7.04	2.63	373

Area - Million hectares
Production - Million tonnes
Yield - Kgs per hectare

Though improved varieties of various pulses have been developed, they are not as high yielding as those of cereals and millets. Besides their low yielding ability they also suffer from several defects such as long duration in case of arhar, susceptibility to deseases and insect pests, too much vegetative growth which results in poor harvest index etc. Despite these constraints, the price incentive offered by the Government are not attractive resulting in low production.

OILSEEDS

India produced around 11 million tonnes of oilseeds in 1985-86 and an area of about 19 million hectares (Table 4 & 5). The major edible oilseeds grown are groundnut, rape and mustard, sesame, safflower, sunflower seeds, soyabean and niger besides around 6 million tonnes of coconuts also produced every year. India has a rich source of other oil bearing forestries like sal, mahua, neem, Karanjia and a host of other seed kernels like mango which can be processed for getting edible grade fats.

Oilseed production during the past 10 years has been stagnant at around 10 to 11 million tonnes (Table 18). The current production of vegetable oils is reckoned at 3.5 million tonnes account for a very low per capita consumption namely 13 gms per capita per day. On the basis of present requirement of oils and fats, production should be 5.5 million tonnes against the present production of 3.5 million tonnes, leaving a gap of 2 million tonnes. The projected requirement of oil and fat by the end of the century will be 6.6 million tonnes equivalent to 24 million tonnes of oilseeds as against present production of 12 million tonnes. The gap between indigenous production of edibl oils and its demand is continuously increasing; This is reflected by the import of 27,000 tonnes of edible oils worth Rs.14 crore in 1975-76, raising to about 16.34 lakh tonnes valued about 641 crores during 1983-84 depecting a 45 fold increase in a period of just 10 years

In terms of area, India is one of the major oilseeds growing nations of the world and can become self sufficient in this respect. But the distressing fact is that the productivity of the crop is lowest compared to cereals and other crops.

Since the scope of expansion of area is limited, the accent will have to be in increasing the per hectare yield. The highest yield achieved was 685 kg per hectare, whereas the highest yield is 5785 kg in Israel.

A state-wise analysis of the individual oil crops shows a mixed trend in area and productivity between 1967-68 and 1983-84 as against a trend growth of 1.3 percent in the total output of oilseeds in the same period, a highest growth of 7.69 percent is shown in Orissa which is a minor groundnut growing state, while it is 3.88 percent in Gujarat, 1.18 percent in Andhra Pradesh, -0.64 percent in Tamilnadu.

In case of rape and mustard while the all India average growth of production was 2.91 percent during the same period, Gujarat, the non-traditional growing area has a highest growth rate of production (19.09%) followed by Rajasthan (10.79%) and 6.67% in West Bengal. In case of the major rape and mustard growing states like Punjab, there is a negative trend production.

In case of sesame as against the All India average compound growth of 1.0 percent of production, Karnataka and Maharashtra have shown the highest growth rate while in Tamilnadu, there is a negative trend (-2.77%).

Soyabean which is a recent introduction as a oilseed crop has shown the highest growth rate both in terms of area as well as production. However, the productivity is only marginal (0.68%) between 1967-68 and 1983-84 (Table 20).

There is a wide gap existing between the yield obtained during scientific trials and the actual yield in case of groundnut, rape and mustard and sesame. The gap is around 6 quintals per hectare in case of groundnut, 8.74 quintals in case of mustard and 3.4 quintals for sesame. The gap is much more pronounced in case of Andhra Pradesh with 15.89 quintals per hectare for groundnut while it is 5.82 quintals in Karnataka, 6.84 quintals in Maharashtra. However, the actual yield performance is almost nearer to national demonstration yield in Orissa (13.58 quintals per hectare) for groundnut.

The major growing states of rape and mustard namely Haryana, Punjab, Rajasthan and Uttar Pradesh have also indicated a wide gap between the national demonstration yield and the actual yield; in Gujarat,a non-traditional growing state, the growth rate in yield is reported to be the highest with 13.59 quintals per hectare againskt the national demonstration yield of 15.33 quintals.

Except in case of Orissa, the gap between the national demonstration yield and the actual yield is very high (Table 21).

The major constraints that stand in the way of boosting production are as follows:

Oilseed crops are largely cultivated under rainfed conditions and only 16.7% of the total area under oilseeds is irrigated (Table 7). Hence, they are highly susceptible to vagaries of the monsoon. Most oilseeds crops are cultivated in marginal and submarginal lands. Since they constitute high risk crops, investment on inputs like fertilisers and plant protection measures are minimal. There is general shortage of quality seeds, lack of organised seed storage have an adverse effect on

production. The plant population is very inadequate to produce high quality seeds. Lastly major constraints exist in marketing, storage and processing, all of which contribute significantly to post harvest losses.

Even a 25% increase substantially from the existing 685 kg per hectare would enable a production of about 15 million tonnes of oilseeds equivalent to about 5 million tonnes of oil.

Non-conventional sources of edible oil

Cottonseed, rice bran, oilseeds of tree origin, red oil palm, oil cakes of various oilseed crops are potential sources for augmenting production of vegetable oils to bridge the gap between demand and supply of vegetable oils in the country. The estimated production of cottonseed oil is around 2.78 lakh tonne as there is scope for increasing this oil upto 5.86 lakh tonnes by the end of the century. Already few major units have begun the production of edible rice bran with foreign know-how and there is potential of 3 lakh tonnes of edible oil from rice bran.

The country has been able to push up the production ofedible grade rice bran oil from just 33,000 tonnes in 1985-86 to nearly 1 lakh tonnes in 1986-87, achieving an increase of as much as 200 per cent. The production is likely to go up further to 1.5 lakh tonnes in 1987-88.

Rice bran potential is estimated about 4.2 million tonnes, which can yield oil upto 6.3 million tonnes. Hence it is a great potential source of edible oil as a by-product of rice, without

additional land outputs. How to harness this valuable source by overcoming the constraints of logistics of collection o bran, its stabilisation, extraction of oil and its processing to suit direct human consumption is an issue which can be discussed by this inter-disciplinary group of experts participating in this discussion.

Table 21

Productivity Gap Between Actual Yield And The Yield Under National Demonstration Trials For Different Oilseeds

(Quintals/hectare)

State	Groundnut			Rape & Mustard			Sesame		
	N.D. (mean)	Actual	Gap	N.D. (Mean)	Actual	Gap	N.D. (Mean)	Actual	Gap
A.P.	26.30	10.11	15.89	-	-	-	-	1.62	-
Assam	-	-	-	-	5.00	-	-	-	-
Bihar	22.10	-	-	8.05	5.24	2.81	-	-	-
Gujarat	-	8.86	-	20.34	13.59	6.75	-	3.64	-
Haryana	20.00	-	-	20.50	8.04	12.46	-	-	-
H.P.	-	-	-	-	-	-	-	-	-
Karnataka	14.68	8.86	5.82	-	-	-	-	3.14	-
Kerala	3.50	-	-	-	-	-	-	-	-
M.P.	-	7.16	-	-	7.36	-	-	1.83	-
Maharashtra	17.12	10.28	6.84	-	-	-	-	2.49	-
Orissa	16.78	13.58	3.20	7.73	4.67	3.06	6.15	4.78	1.37
Punjab	12.42	7.24	5.18	-	8.59	-	-	-	-
Rajasthan	-	9.48	-	21.25	7.91	13.34	-	1.73	-
Tamilnadu	-	10.11	-	-	-	-	-	2.97	-
Tripura	-	-	-	12.50	-	-	-	-	-
U.P.	7.64	6.42	1.22	17.00	5.24	11.76	-	2.46	-
West Bengal	-	-	-	8.49	5.97	2.52	6.35	5.21	1.14
National average	15.61	9.53	6.08	15.33	6.59	8.74	6.25	2.83	3.4

Source : Agric.Situat India, Aug. 1986

AGRICULTURAL INPUTS

Seeds : A major component of strategy for agricultural production is the expansion of area under high yielding variety of seeds. Distribution of certified quality seeds increased to 55 lakh quintals during 1985-86, compared to 25.1 lakh quintals during the year 1980-81. Area covered under high yielding varieties has increased from 15.38 million hectares in 1970-71 to 60.6 million hectares by 1986-87 (Table 22 & 23).

Fertilisers : Expansion of fertiliser application specific to crop, its variety, season and region of cultivation is an important plank in the strategy for increasing agricultural production. Total off-take of fertilisers increased from 21.8 lakh in 1970-71 to 87.4 lakh tonnes during the year 1985-86 (Table 24). The current national average of consumption of over 50 kg. per hectare of gross cropped area is very low, compared to the average consumption of 150 kg of nitrogen, 65 kg. phosphorous and 150 kg. potash per hectare in countries like China. Only about 1/3 of cropped area is estimated to be receiving the benefit of fertiliser application.

Out of 82.4 lakh tonnes consumption of fertilizers, 57.5 lakh tonnes constituted domestic production indicating the gap between the production and demand. Hence, production has to be stepped up to accelerate per hectare of productivity of foodgrains.

Irrigation Potential :

The increased trend of unutilised irrigation potential is a cause for serious concern as against the total irrigation potential of 72.1 million hectares utilisation is only upto 64.11 million hectares

during 1986-87. The problem is more severe in the case of major schemes involving storage and utilisation of surface water. Water logging and salinisation associated with huge surface water scheme have to be solved by undertaking proper measures (Table24).

2.3 Dry Land/Rainfed Farming :

About 70% of the total cultivated area in the country is dry land/rainfed area and a large proportion of the output of important crops such as coarse cereals, pulses and oilseeds comes from these areas. These areas constitute 42% of the total foodgrains production.

Production in these areas is quite low and caught in a vicious circle of high risk, low investment, poor technology and low production. A break-through has to be achieved by land development programmes, water harvesting storage structures and coverage of area with improved/drought resistant seeds and fertilisers.

Losses due to floods are estimated to be around 2000 crores a year, with 50 lakh hectares cropped area is affected. About one half of the cultivable land is subject to soil erosion, which suffers from water logging and salinity, allowing any one shift cultivation.

2.4 Distribution of Land :

Agricultural technology should be adopted to avail the maximum resources which are free gifts of nature. Nearly 40% of the land or 56 million hectares is operated by the top 8% of households, each owing over 8 hectares of land. On the other hand 47% of the households operate only 7% of the land or a total of 9.6 million hectares.

Therefore, meaningful redistribution programmes should be implemented and small farmers would be given more incentives in order to achieve higher productivity.

Table 22

Area Under HYV

(million hectares)

Crop	1982-83	1983-84	1984-85	1985-86	1986-87*
Paddy	18.8 (49.1)	21.7 (52.6)	22.8 (55.3)	23.8 (58.2)	25.8
Wheat	17.8 (75.5)	19.4 (78.6)	19.1 (80.9)	19.7 (85.3)	20.7
Jowar	4.4 (26.9)	5.3 (32.3)	5.2 (32.1)	4.9 (31.0)	5.8
Bajra	4.7 (43.0)	5.4 (32.4)	5.2 (34.5)	4.6 (37.3)	5.9
Maize	1.7 (29.7)	1.9 (32.4)	2.0 (34.5)	2.2 (37.3)	2.4
Total :	47.5	53.7	54.1	55.2	60.6

* Targets
Figures in parentnesis give the percentage of the HYV area to the total area under the crop.

DEVELOPMENT OF MODELS AND RESULTANT FOOD PRODUCTION SCENARIOS BY 2010 A.D.

Earlier studies on food and population have projected the demand for foodgrains/oilseeds as mainly a function of per capita income, consumption expenditure and the growth of income and population; while the population projections were based on assumed growth rates by 2001 A.D.[1-7] Normative demand approach has also been adopted in some studies [8,9] for projecting demand-supply gap by the turn of the century.

In the present study, an effort has been made to relate the likely population growth and food production based on the existing trends. Attempts have also been made to use growth models with the intention of appraising the policy makers about the need for meeting the food demands of the country by 2010 A.D. In view of these considerations, a "Crisis Analysis Approach" has been used to study the Food Futures and Food Security by 2010 A.D. This approach is aimed at elucidating the gap between supply and demand for certain basic food commodities based on normative demand and population projections.

The normative demand approach considers the basic food needs for meeting the minimum protein-calorie requirements of the population. On the basis of this concept the demand for cereals, pulses and oilseeds has been projected upto 2010; the strategies relevant to meet the minimum needs of the projected population have also been discussed.

The factors considered for this purpose are;

(i) Population in India, using suitable growth models and its projection for 2010 A.D.; identification of high and low growth

models

(ii) Distribution of population by age and sex

(iii) The protein-calorie requirement of groups with different physiological activities

(iv) Proximate composition of major food raw materials adjusted to farm level based on the percentage of edible portions and the current price.

(v) The state-wise dietary pattern conforming to consumption pattern and food habits

Population in India, high/low growth models and projection for 2010 AD

The population in our country from 439 million in 1961 to 685 million in 1981; but nearly 50 years were necessay for the population to double between 1901 to 1961 (Table 27 & 28). In terms of absolute growth, rapid growth was noticed between 1971-81, with an addition of 137 millions as against 108.9 million during the previous decade (1961-71).

Several projections have been made on the likely population by 2001 A.D.[1-9] The latest data avaialble from the Registrar General and Census, India, United Bureau of Science, The United Nations and by R.H. Cassen are given in Table 28a. The main frame work of analysis is based on the time span for achieving NRR=1. Except the first estimate, other estimates do not pressume NRR=1 to be achieved before the latter part of the next decade.[7a]

In view of this, an attempt has been made to make population projections by using suitable growth models,designed from the trends in

population growth since the beginning of this century. To start with, 80 models were tested for their sound basis or reliability in describing the relationship of population growth with time. Out of these, the Exponential, the Pearls and the Gompertz growth models "at and squared time" were found to be good fits (the Correlation Coefficient in each case was >0.99). Earlier studies [11,12] had however, shown that growth of any biological material including population generally followed a logistic pattern taking the shape of a "sigmoid" curve. In view of this, though projections based on exponential growth model have been provided , only the logistic models have been used for our future analysis.

The projected population based on the above three models upto 2010 A.D. is presented in Annexure. From the above analysis it is assumed that under E1 and L1 models the population will double bynext 25 years indicating an explosive growth while under L2 and G2 models it is anticipated the population will follow a very rapid growth by doubling by next 37 and 47 years respectively (Table29 & 30).

Following are the population projections used in subsequent discussion of the study.

Year	L2	L1	G2	G1
1985	721	755	715	746
1990	790	864	775	839
1995	865	995	838	945
2000	947	1153	905	1066
2005	1036	1343	974	1203
2010	1133	1573	1043	1357

- L1 and L2 are Pearl models on squared time & time
- G1 and G2 are Gompertz models on squared time & time

The equations derived from different growth models used for population projections are presented in Table 31.

In the following discussion, the L1 and G1 are treated as high growth models and L2 and G2 as low growth models.

Distribution of population by age and sex

Though the ratio of female to male population has declined upto 1971, it showed an improvement by the year 1981. It is assumed for our analysis that the ratio will further improve and will reach unity by 2010 A.D.

Regarding age-wise distribution projection of population, the 0-14 age group is projected to come down by 7% and 10% respectively under L1 and G1 models, while the reduction is only to the extent 5% and 3% respectively under L2 and G2 models.

Protein-Calorie requirement of population

For estimating the nutritional requirement, the standard unit is defined as a sedentary adult of weight 55 kg at 1.6 BMR, requiring 2400 KCal of energy. The per capita daily protein requirement is stipulated to be 55 g working our to 1 g of protein per kg body weight. The nutritional requirement of sexes over different age groups and sex was expressed in terms of standard units, based on the FAO/UNU report on 'Energy and Protein Requirement' (1985).

Based on the above energy coefficient has been derived using the following equation.

$$Eo = \frac{[(M1 + F1)\ p1/2 + (M2 + F2)\ p2/2 + (M3 + F3)\ p3/2] \times Pt}{100}$$

where

Eo = Energy coefficient

p1,p2,p3 = Percentage population in each age group

M1,M2,M3 = Standard units for males of 3 age groups in terms of described standard adults

F1,F2,F3 = Standard units for females of 3 age groups in terms of described standard adults

P_t = is the total population for a particular year

Here M1 = 0.7, F1 = 0.7; M2 = 1.0, F2 = 0.825; M3 = 0.8, F3 =0.7

The total energy coefficient derived from different models is presented in table 32.

Using the above equation a composite unit is obtained which can then be used irrespective of age, sex and the activity levels in assessing the requirement of foodgrains and oilseeds. The energy units obtained under different models is presented in table 33.

Proximate composition and prices of food materials fo the development of models of food formulations

The proximate composition and current price of rice, wheat, ragi, millets, pulses, oilseeds, sugar, milk, flesh foods and tubers, with respect to protein and energy were used and leastcostiso-protein and iso-calorie formulations were worked out using Linear Programming

Techniques. 16 such diet combinations based on rice and wheat were obtained which provide minimum recommended requirements of energy and protein. The cost per capita per day as well as the individual diet composition satisfying the constraints is presented in table 34.

Diet Composition of different states

The state-wise dietary pattern was derived from several food habit studies. The total energy units were distributed over states in proportion to their population in 1981. The requirement of food items for each state was calculated based on their respective dietary pattern (Table 35).

The final analysis of the demand for food raw materials were made based on the above analysis since cereals, pulses and oilseeds form more than 80% of total diet composition, presently for our study cereals covering rice, wheat, millets as well as pulses and fat in terms of oilseeds have been used for our future discussion (Table 36).

ESTIMATED DEMAND FOR CEREALS, PULSES & OILSEEDS IN 2010 A.D.

Rice : The demand for rice at a nigh population growth model (L1) is expected to reach 134 million tonnes in contrast, at low growth model (G2), the demand would be 88 million tonnes (Table 37). With 10% on feed, seeds and wastage, the requirement would be 147 million tonnes and 97 million tonnes at farm level. At the present level of production, the additional production required to be achieved will be 74 million tonnes (according to L1 model) and/or 32 million tonnes (according to G2 model) (Table 38).

Wheat: The projected demand for wheat under higher logistic models are 74 million tonnes at consumer level and 48 million tonnes at lower logistic models. Additional production requirement at the present production of 48 million tonnes would be 26 million tonnes and just sufficient to meet the demand under lower growth models. At the farm level, would be higher at 47 million tonnes and 9 million tonnes at a lower level (table 39).

Ragi & Millets : As against the present production level of 2.5 million tonnes of ragi the projected demand by 2010 A.D. will be 3.6 million tonnes and 2.3 million tonnes respectively. The additional production required with higher logistic growth wll be only 1.5 million tonnes by 2010 A.D., while the present production level is sufficient to meet demand at lower estimate even by 2010 A.D.(table 41 & 42).

In case of millets, the projected demand ranges from 15 million tonnes to 10 million tonnes, while the production is around 27 million tonnes, indicating a surplus production of 12-17 million tonnes at the

present production level. Even projecting 15% of the production required for industrial processing, feed, seed and wastages, the total demand will be around 20 million tonnes by 2010 A.D. even at higher growth (table 43 & 44).

Pulses : As against the present production of 12-13 million tonnes, the demand is projected between 23 and 34 million tonnes by 2010 A.D. The additional production required to meet the demand is expected to be 10-21 million at lower and higher projections (table 45 & 46).

Oilseeds/fat : Presently the demand for edible fat is 51 lakh tonnes and the supply gap is being met by imports (with 35.5 lakh tonnes of production and 51 lakh tonnes of estimated demand). By 2010 A.D., the gap is expected to widen with the projected demand even at lower level being 13 million tonnes in terms of fat and 36 million tonnes expressed in terms of oilseeds at consumption level. The composition of weighted oil content is presented in table below. At the farm level, the gap will be still higher after making provision of 12.5% for feed, seeds, direct domestic consumption and wastages. In terms of oilseeds the production requirement would be around 62 million tonnes at higher level and 43 million tonnes even the lower demand level at the farm level (table 47 & 48).

Weighted Average Yield Of Oil From Edible Oilseeds

Item	% oil	Production ('000 tonnes)	Ratio to total prodn.	Weighted contribution to total oil (in %)
Groundnut	40.1	5771.8	0.64	25.66
Mustard	39.7	1433.1	0.16	6.35
Niger	39.0	95.8	0.01	0.39
Safflower	25.6	231.3	0.02	0.51
Soya	20.0	1000.0	0.11	2.20
		8902.7	0.98	36.81

ESTIMATED DEMAND OF CEREALS PULSES AND OILSEEDS AT FARM LEVEL BY 2010 A.D. BY VARIOUS MODELS

(Million tonnes)

	L1	L2	G1	G2
Rice	147	106	129	97
Wheat	83	59	72	54
Millets	21	16	19	15
Pulses	48	28	34	26
Oilseeds	63	46	54	41

ESTIMATE OF PRODUCTION OF CEREALS, PULSES AND OILSEEDS BASED ON ALTERNATIVE GROWTH MODELS

In order to study the future panorama of foodgrains and oilseeds sectors, efforts are made to project the production by 2010 A.D. In view of the fact that the food production may not follow a linear trend, 10 different growth models were fit and tested for their efficiency, to project the foodgrain and oilseeds production by 2010 A.D. The logistic growth models were found to give a best fit. The national potential yield is taken as the optimum yield levels aimed at in the long range and the average national demonstration yields achieved under All India Coordinated Research Projects was taken as the most plausible yield which can be arrived by 2010 A.D. and doubling the present yield considered to be achieved immediately. Based on the above assumption, higher, middle and lower logistic models were developed to project the production by 2010 A.D. The individual crops are discussed separately.

The equations derived for different models with respect to rice, wheat and oilseeds under different yield assumptions is presented below:

Equations derived for different models for different yield level

A. Rice

L1 = 600/[1+93.5374 Exp {-0.0279(year-1900)}] (n=7, r=-0.961)

G1 = 600 exp [-5.4734 exp {-0.0103027(year-1900)}] (n=7, r=-0.961)

L2 = 450/[1+72.7578 exp {-0.02878(year-1900)}] (n=7, r=-0.961)

G2 = 450 exp [-5.36794 exp {-0.01656(year-1900)}] (n=7, r=-0.961)

L3 = 250/[1+46.546 exp {-0.032(year-1900)}] (n=7, r=-0.961)

G3 = 250 exp [-5.4548 exp {-0.0159358(year-1900)}] (n=7, r=-0.960)

B. Wheat

L1 = 225/[1+2514.4 exp {-0.077688(year-1900)}] (n=10, r=-0.979)

G1 = 225 exp [-27.8858 exp {-0.034313(year-1900)}] (n=10, r=-0.982)

L2 = 180/[1+2520.3 exp {-0.0811568(year-1900)}] (n=10, r=-0.980)

G2 = 180 exp [-35.02 exp {-0.03883(year-1900)}] (n=10, r=-0.983)

L3 = 135/[1+2910.89 exp {-0.0877225(year-1900)}] (n=10, r=-0.981)

G3 = 135 exp [-54.044 exp {-0.046807(year-1900)}] (n=10, r=-0.983)

C. Oilseeds

L1 = 50000/[1+37.354 exp {-0.027677(year-1900)}] (n=10, r=-0.661)

G1 = 50000 exp [-4.86679 exp {-0.0137378(year-1900)}] (n=10, r=-0.662)

L2 = 37500/[1+31.431 exp {-0.0302(year-1900)}] (n=10, r=-0.662)

G2 = 37500 exp [-5.08418 exp {-0.0167385(year-1900)}] (n=10, r=-0.663)

L3 = 30000/[1+28.15 exp {-0.033241(yer-1900)}] (n=10, r=-0.662)

G3 = 30000 exp [-5.5582 exp {-0.02016(year-1900)}] (n=10, r=-0.663)

Rice : Under the assumption that different levels of inputs are optimised, the high and lower production projections are 112 million tonnes and 103 million tonns under pearl growth model and 105 and 97 million tonnes under Gompertz growth model (table 17).

Wheat : The production predicted to be achieved at a higher growth is 151 million tonnes and 99 million tonnes at a lower rate. Since the coefficientof correlation is >0.9,the prediction is expected tohold good. Even at the lower production projection, the surplus predicted is 10 million tonnes by 2010, indicating the volume of stock required

to be handled by FCI and or any other agency (table 50).

Pulses : In view of the stagnating growth, neither the exponential nor logistic growth models were found to be best fits. Hence, the trend could not be arrived at. Therefore, following assumptions have been made to project the supply.

(i) Optimum productivity of 1772 kg/hec to be achieved under National Demonstration trials to be reached by 2010 A.D. For this purpose the production will grow at a compound growth of 1.102 tonnes/hectare (Model I).

(ii) Increasing the yield by 54% (.83 tonnes/ha) by improved pest management methods as presented in All India Coordinated Research Project (Model II).

(iii) Doubling the yield due to irrigation and crop protection (Model III).

Based on these assumption, following production projections are arrived.

Year	Model I	Model II	Model III
			(in million tonnes)
1990	14.5	13.6	13.2
1995	16.2	14.3	13.6
2000	18.0	15.0	14.0
2005	20.3	15.8	14.4
2010	23.0	16.67	14.7

On the basis of the above analysis, the maximum middle and lower production that could be achieved is 23 million tonnes by I

ESTIMATED PRODUCTION OF CEREALS, PULSES AND OILSEEDS IN 2010 A.D. UNDER VARIOUS GROWTH MODELS

(Million tonnes)

	L1	L2	L3	G1	G2	G3
Rice	112	110	105	103	101	97
Wheat	151	135	119	119	110	99
Millets #	26	26	26	26	26	26
Pulses *	23	17	15			
Oilseeds	18	18	17	17	17	16

Present production

* The values obtained by considering yield of 1772 Kg/h (National demonstration trials), 54 % increased production due to improved management; and 100 % increase in production due to irrigation, and crop protection respectively (see page 34)

model, 15.6 million tonnes by II model and 14.7 million tonnes III model by 2010 A.D.

At the lower demand projection, the production under Model I is expected to just meet the requirement, while under higher demand growth, the gap will be around 11 million tonnes. This could result in a fall in percapita availability from the present level of 40.6g/day (1986) to still far below the recommended allowance.

Oilseeds/Fat : 6 growth models have been fit for the trend production data on oilseeds. However, the coefficient of correlation was only 0.66 for all the models. The high, middle and low growth models were derived based on National Potential Yield, Average National Demonstration Yield and the average of the above two. The predicted yield is almost similar for all the models developed. The higher estimate is just 18 million tonnes and lower estimate is 16.4 million tonnes (table 51). The demand supply gap ranges between 26.29 million tonneswhich indicates the enormity of the effort required to meet the requirement of fat by 2010 A.D.

Ragi & Millets : In case of ragi and millets, the projected demand under different growth models are invariably lower than present production levels, it is assumed that part of the cultivated land could be diverted to meet the production requirement of cereals and pulses.

ESTIMATE OF SUPPLY & DEMAND BALANCE FOR CEREALS, PULSES AND OILSEEDS IN 2010 A.D.

An analysis of the projected demand and supply under high and low logistic models brings out the following:

Rice : The demand and supply balance indicates a negative balance which is projected to increase from 10 million tonnes in 1990 to 35 million tonnes under high estimate and projected to get equalised under low estimate (Table 52).

Wheat : A reversal in the trend is indicated in case of wheat with a positive balance ranging from 68 million tonnes to 48 million tonnes showing a surplus production even at low logistic growth (Table 53).

Millets : Even in case of millets the demand under high and low logistic growth will be betwen 17 to 12 million tonnes which is much lesser than even the present production level of 22 million tonnes indicating a surplus at present production level itself (Table 54).

Ragi : In case of ragi even at high logistic growth only around 1.5 million tonnes of additional production even at present level of production is required to meet the future demand..

Pulses : The projected demand and supply balance indicates a gap in supply even under low demand estimates at the level of 11 million tonnes and as high as 25 million tonnes under high demand projection (Table 55).

DEMAND AND SUPPLY BALANCE FOR CEREALS, PULSES, AND OILSEEDS AS ESTIMATED BY VARIOUS MODELS

	High, L1			Medium, G1			Low, G2		
	D	S	Gap(S-D)	D	S	Gap(S-D)	D	S	Gap(S-D)
Rice	147	112	- 35	129	103	- 26	97	97	Nil
Wheat	83	151	+ 68	72	119	+ 47	54	99	+ 45
Millets	21	26	+ 5	19	26	+ 7	15	26	+ 11
Pulses	48	23	- 25	34	17	- 17	26	15	- 11
Oilseeds	63	18	- 45	54	17	- 37	41	16	- 25

* Present production being 26.5 million tonnes

Oilseeds : The gap is projected to continue even at high logistic supply growth model by 2010 A.D. ranging from 22 million tonnes to 45 million tonnes between 1990 and 2010 A.D. (Table 56).

An over view of the additional requirement to meet the food challenges by 2010 A.D. indicates a critical level of 83 million tonnes in case of rice, 36 million tonnes for wheat, 35 million tonnes for pulses and 50 million tonnes for oilseeds. This presents enormous effort in the food front to meet the crisis situation by 2010 A.D. (Table 57).

Even at lower demand estimates nearly doubling of production in case of pulses and over 200 times in case of oilseeds and rice is required to meet food requirement at 2010 A.D.

FOOD SCENARIO AND FOOD SECURITY BY 2010 A.D.

Food Scenario

Based on the foregoing analysis of projected demand and supply scenarios under different growth models, the future food scenario could be summarised as follows:

1. The 1981 level population is expected to double by 2006 A.D. (by next 25 years) under high logistic growth model and by 2028 A.D. (by next 47 years) under low logistic growth model indicating either explosive or very rapid growth. It is anticipated that the population growth will follow Pearl model at time based on the present trend unless the Government intervention is sufficient to meet the new challenges.

2. The projected production of food raw materials is anticipated to follow low logistic model indicating the widening of the gap between demand and supply.

3. Based on normative demand projections, production of rice, pulses and oilseeds is anticipated to fall short of supply while surplus production of wheat is projected by 2010 A.D.

4. The resulting scenario is a negative supply demand balance for rice, pulses and oilseeds and a surplus stock in case of wheat and millets.

Security by 2010 A.D.

The future challenges of food security to meet the food futures as indicated earlier could be presented in the form ofa Relevance Tree.

Future Challenges Of Food Security

- 1 Meeting normative demand for food of the projected population
- 2 Boosting production of rice, pulses and oilseeds
- 3 Monitor cost effective buffer stuffs and surplus wheat and millets

1. Meeting Normative Demand For Food

- (i) Reduce per capita demand
  - Achieve low population growth
  - Ensure balanced food intake
    - Impart nutrition education
- (ii) Ensure change in dietary pattern to incorporate more surplus wheat and millets
- (iii) Develop technology for manufacture of staple convenience products based on wheat and millets within reach of low income group incorporating consumer concept eg. stuffed buns, spiced buns etc.

2. Boosting Production Of Rice, Pulses & Oilseeds

- Achieve national potential/ demonstration yields
- Reallocate areas from surplus crops to deficit crops
- Effect conservation of losses and utilisation of new sources of fat
  - Reduce processing losses by modernization of industry
  - Shift basic processing units to production centres
  - Reduce post harvest storage and handling losses

3. Effective Marketing And Distribution

- Maintain cost-effective buffer stuffs
- Operate public distribution to achieve normative consumption

TECHNOLOGICAL CHALLENGES/ISSUES

During the next few decades developments in India food situation will present new challenges and responsibilities; they are :-

1. Need for optimisation of agricultural output by aiming at National Potential Yield as a long term policy but yet achieve atleast the Average National Demonstration Yield especially with respect to such states where the gap between N.D. yield and the present yield is wider as observed in the earlier sections, as a short term policy.

2. The policy makers should prepare themselves as a worst situation to meet the higher demand for foodgrains and oilseeds as noticed under higher growth model L1, but yet aim at lower population growth (G2) as a long term policy.

3. One of the most important technological break through in production of pulses is the short duration varieties evolved by Indian Agricultural Scientists which can be fitted in a series of multiple cropping, double cropping and inter cropping patterns with cereals and other crops, without affecting the traditional practice and still retaining the land fertility. The series of methods suggested are;

a. Crop rotation :

	Region	Estimated additional production
Wheat - arhar (in 1 mil.ha.)	Punjab, Haryana, Western U.P., Raj.	1.5 million tonnes
Cereal - gram	Delhi, Eastern U.P., Bihar	1.0 million tonnes

b. Multiple Cropping :
(three crop rotation)

Wheat - mung - rice
Wheat - mung - maize
Wheat - mung - bajra
Wheat - mung - sorghum

c. Inter-cropping of
Greengram :

Potato)	5-10 million hectares	About 3.0 million
Millets)	more land under	tonnes of addi-
Sugarcane)	greengram	tional production

Based on the above measures nearly 7.0-7.5 million tonnes of additional production of pulses can be achieved for bringing down the gap in next 25 years.

Besides this, several pockets of land in different parts of the country which either remain fallow or are rendered uncultivable including rice fallows in Eastern and Central India and Southern India could be brought under cultivation of pulses. This would provide two more million hectares under high yielding varieties resulting in the production of 1.0 to 1.5 million tonnes.

Thus totally 9 to 10 million tonnes of additional pulses could be raised.

4. Recently new varieties of tubers like Cassava have indicated higher yield upto 30-40 tonnes per hectare. Therefore, immediate potential exists for doubling the production level of tubers from the present 20 million tonnes. Hence incorporation of tubers of about 50 gms per capita per day, to start with, would go a long way in reducing the gap

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of foodgrains.

5. Under Operation Flood III, the targeted production of milk by 1989-90 is around 60 million tonnes and hence it may not be unreasonable to assume 50 gms per capita per day which will drastically bring down the normative requirement of pulses, thus reducing the demand-supply gap even at high growth model (L1) in 2010 A.D.

6. In view of the technological feasibility of producing edible cake flour from oilseeds incorporation of the edible cake flour upto a range of 20 gms per day would reasonably bring down the gap in requirement of pulses.

7. The total estimated post-harvest losses during storage and processing is around 7% of the total production in the country. At least minimum R&D effort to cut down the losses during storage and processing would result avoiding import of pulses which is presently being done.

8. Regarding oilseeds, recently new high yielding variety of groundnut - one of the major oilseed crops of the country, is reported to have been developed (JL-24) with an average yield of 1,800 kgs perhectare under rainfed conditions and 2,500 kgs per hectare in irrigated fields and harvest period within 3 months. The variety was reported to be suitable for growing conditions, weather and soil as prevailing in Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra. The introduction of the above variety presents a good potential for increasing the availability of the oilseeds in 2010 AD.

Simularly trials conducted at BARC, Bombay on another variety (T.G.) has indicated the potential for increasing the oil yield from 40 to 45 or 60% through proper adoption. Presently Rs.1500 Crore worth of edible oil is imported. If the technology is fully utilised doubling of production from 12 million to 25 million tonnes would be plausible achievement in next 25 years.

9. Necessary policy measures are required to encourage use of wheat in Indian diet especially in non-traditional regions, thereby reducing the noticed gaps in rice. The technology required for developing and extension of shelf life through package for such staple foods like Naan, Khakras, Chapati etc., would go a long way in extending use of wheat in Indian diet.

Table 1

Percentage Distribution Of Area Under Foodgrains

Crop/Group of crops	1950-51	1960-61	1970-71	1980-81	1985-86
Rice	31.7	28.5	30.2	31.7	32.2
Wheat	10.2	11.2	14.7	17.6	18.2
Coarse cereals	38.7	38.9	37.0	33.0	30.9
All cereals	80.4	79.6	81.9	82.3	81.3
All pulses	19.6	20.4	18.1	17.7	18.7
All foodgrains	100.0	100.0	100.0	100.0	100.0

Table 2

Total Area And Production Of Different Cereals in 1985-86

Crop	Area (000 hectare)	Production ('000 tonne)	
Rice (in terms of paddy)	40,912	64,153	1,568
Wheat	23,074	46,885	2,032
Jowar	15,789	10,123	641
Bajra	10,687	3,684	345
Maize	5,879	6,980	117
Ragi	2,355	2,522	107
Small millets	3,169	1,297	409
Barley	1,379	1,952	142
Total	1,03,244	1,37,506	

Table 1a

All-India Estimates Of Production Of Foodgrain Crops

1949-50 To 1985-86

Year	Cereals	Pulses	Total Foodgrains	Oilseeds
1949-50	50.75	10.04	60.80	4.67
1950-51	45.81	9.20	55.01	4.98
1951-52	46.48	9.12	55.60	4.85
1952-53	51.95	9.83	61.78	4.66
1953-54	61.20	11.12	72.33	5.16
1954-55	59.09	11.65	70.74	6.14
1955-56	57.63	11.71	69.34	5.51
1956-57	60.31	12.15	72.46	6.12
1957-58	56.52	10.11	66.63	6.13
1958-59	65.59	13.22	78.80	6.98
1959-60	65.25	11.87	77.12	6.44
1960-61	69.59	12.73	82.33	6.90
1961-62	70.69	11.71	82.40	7.53
1962-63	68.79	11.54	80.33	6.84
1963-64	70.62	10.08	80.70	7.00
1964-65	76.95	12.41	89.37	8.57
1965-66	62.40	9.94	72.35	6.40
1966-67	65.88	8.35	74.23	6.46
1967-68	82.95	12.10	95.05	8.30
1968-69	83.60	10.42	24.02	6.85
1969-70	87.81	11.69	99.50	7.74
1970-71	96.60	11.82	108.42	9.26
1971-72	94.07	11.69	105.17	8.75
1972-73	87.12	9.91	97.03	6.85
1973-74	94.66	10.01	104.67	8.85
1974-75	89.81	10.01	99.83	8.53
1975-76	108.00	13.04	121.03	9.90
1976-77	99.81	11.36	111.17	7.83
1977-78	114.43	11.97	126.41	9.00
1978-79	119.72	12.18	131.90	9.35
1979-80	100.48	8.38	108.85	8.08
1980-81	118.96	10.63	129.59	9.34
1981-82	121.79	11.51	133.50	12.08
1982-83	117.66	11.86	129.52	10.10
1983-84	139.48	12.89	142.37	12.69
1984-85	133.58	11.96	145.54	12.95
1985-86	137.50	12.97	150.47	11.15

Table 3

Area, Production & Productivity Of Maize

Year	Area ('000 Ha)	Production ('000 tonne)	Productivity (kg/Ha)
1950-51	NA	2357	NA
1960-61	4987	4060	926
1970-71	5839	7413	1270
1980-81	6005	6957	1158
1985-86	5879	6890	1172

Table 3a

Production Of Pulses (1986)

Crop	Area ('000 Ha)	Production ('000 tonnes)
Gram	7653.8	5683.1
Tur	3206.0	2426.4
Other pulses	12957.4	4854.5
	23817.2	12964.0

Table 3b

Percapita Availability Of Cereals And Pulses

Year	Population	Percapita net availability (g)	
		Cereals	Pulses
1981	690.1	416.2	37.5
1982	705.2	414.8	39.2
1983	720.3	3969	39.5
1984	735.6	436.1	41.8
1985	750.9	424.4	38.9
1986	765.1	448.2	40.2

Table 4

Gross Area Under Major Crops

(in million hectares)

Commodity	1970-71	1975-76	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
Rice	37.59	39.48	40.28	40.48	39.41	40.15	40.71	38.23	41.24	41.15	40.19
Wheat	18.24	20.45	21.46	22.64	22.17	22.28	22.14	23.57	24.67	23.56	23.07
Jowar	17.37	16.09	16.32	16.15	16.67	1.81	16.66	16.37	16.43	15.44	15.79
Maize	5.85	6.03	5.68	5.76	5.72	6.01	5.94	5.72	5.86	5.80	5.88
Bajra	12.91	11.57	11.10	11.39	10.58	11.63	11.7[illegible]	10.91	11.83	10.62	10.69
Total Cereals	**101.78**	**103.73**	**104.82**	**105.35**	**102.95**	**104.21**	**105.30**	**102.25**	**107.62**	**103.93**	**103.24**
Gram	7.84	8.32	7.97	7.71	6.99	5.58	7.87	7.40	7.16	6.91	7.66
Tur	2.66	2.67	2.63	2.64	2.73	2.84	3.00	2.93	3.22	3.16	3.21
Total pulses	**22.53**	**24.45**	**23.50**	**23.66**	**22.26**	**22.46**	**23.84**	**22.83**	**23.54**	**22.74**	**23.82**
Groundnut	7.33	7.22	7.03	7.43	7.16	6.80	7.43	7.22	7.54	7.17	7.31
Rapeseed & Mustard	3.32	3.34	3.58	3.54	3.47	4.11	4.[illegible]	3.83	3.87	3.99	3.80
Total Oilseeds	**16.64**	**16.92**	**17.17**	**17.71**	**16.94**	**17.60**	**18.91**	**17.75**	**18.69**	**18.92**	**18.87**

Table 5

Production Of Major Crops

(in million tonnes)

Commodity	1970-71	1975-76	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
Rice	42.23	48.74	52.67	53.77	42.33	53.63	53.25	47.12	60.10	58.34	64.15
Wheat	23.83	28.85	31.75	35.51	31.83	36.31	37.45	42.79	45.48	44.07	46.89
Jowar	8.11	9.50	12.06	11.44	11.65	10.43	12.06	10.75	11.92	11.40	10.12
Maize	7.49	7.26	5.97	6.20	5.60	6.96	6.90	6.55	7.92	8.44	6.89
Bajra	8.03	5.74	4.73	5.57	3.95	5.34	5.54	5.13	7.72	6.05	3.60
Total cereals	**96.60**	**107.99**	**114.44**	**119.72**	**101.13**	**118.96**	**121.79**	**117.66**	**139.48**	**133.58**	**137.50**
Gram	5.20	5.88	5.41	5.74	3.36	4.33	4.64	5.29	4.75	4.56	5.68
Tur	1.88	2.10	1.93	1.89	1.76	1.96	2.24	1.99	2.58	2.53	2.43
Total pulses	**11.82**	**13.04**	**11.97**	**12.18**	**9.57**	**10.63**	**11.51**	**11.86**	**12.89**	**11.96**	**12.97**
Groundnut	6.11	6.75	6.09	6.21	5.77	5.01	7.22	5.28	7.09	6.43	5.55
Rapeseed and mustard	1.98	1.94	1.65	1.86	1.43	2.30	2.38	2.21	2.61	3.07	2.64
Total oilseeds	**9.63**	**10.61**	**9.66**	**10.10**	**8.74**	**9.37**	**12.08**	**10.00**	**12.69**	**12.95**	**11.15**

Table 6

Yield Per Hectare Of Major Crops

(Kgs/hectare)

Commodity	1970-71	1975-76	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
Rice	1123	1235	1308	1328	1074	1336	1308	1231	1457	1417	1568
Wheat	1307	1410	1480	1568	1436	1613	1691	1816	1843	1870	2032
Jowar	466	591	739	708	699	660	727	657	725	715	641
Maize	1279	1203	1051	1076	979	1159	1162	1145	1352	1456	1172
Bajra	522	496	426	489	373	458	470	469	653	519	345
Total cereals	**949**	**1041**	**1100**	**1136**	**982**	**1142**	**1157**	**1151**	**1296**	**1285**	**1332**
Gram	663	707	678	745	481	657	590	715	663	661	743
Tur	709	786	735	716	643	689	745	618	801	819	757
Total Pulses	**524**	**533**	**510**	**515**	**385**	**473**	**483**	**519**	**548**	**526**	**544**
Groundnut	834	935	806	835	805	736	972	732	940	898	759
Rapeseed and Mustard	564	580	460	525	411	560	541	577	673	771	694
Total Oilseeds	**675**	**627**	**563**	**570**	**516**	**532**	**639**	**663**	**679**	**684**	**591**

Table 7

Irrigated Area Under Different Crops

(Million hectares)

Commodity	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84
Rice	15.22 (38.7)	14.77 (38.4)	15.20 (40.2)	16.86 (41.6)	16.91 (42.8)	16.34 (43.5)	17.11 (41.9)	16.05 (41.7)	17.43 (42.1)
Wheat	12.56 (61.6)	13.59 (65.1)	13.72 (64.3)	14.87 (66.0)	15.03 (67.9)	15.52 (69.7)	15.47 (69.9)	17.05 (72.3)	17.89 (72.4)
Jowar	0.79 (4.9)	0.80 (5.1)	0.66 (4.0)	0.77 (4.8)	0.63 (3.8)	0.63 (3.8)	0.63 (3.8)	0.62 (3.8)	0.65 (3.9)
Bajra	0.59 (5.1)	0.53 (4.9)	0.47 (4.2)	0.50 (4.4)	0.63 (5.9)	0.64 (5.4)	0.70 (5.9)	0.65 (5.9)	0.55 (4.7)
Maize	0.93 (16.2)	1.06 (17.7)	0.91 (15.9)	0.95 (16.3)	1.36 (23.5)	1.20 (19.7)	1.15 (19.4)	1.22 (21.3)	0.98 (16.7)
Barley	1.53 (64.4)	1.25 (55.9)	1.08 (53.9)	0.95 (51.7)	0.90 (59.8)	0.91 (59.4)	0.83 (47.7)	0.71 (47.4)	0.66 (47.2)
Total cereals	**32.14** (31.0)	**32.45** (32.0)	**33.50** (32.1)	**35.32** (33.5)	**35.84** (34.7)	**35.59** (33.8)	**36.24** (34.3)	**36.62** (35.6)	**38.49** (35.6)
Total pulses	**1.95** (7.9)	**1.77** (7.5)	**1.70** (7.1)	**1.89** (7.9)	**1.95** (8.8)	**2.02** (8.9)	**2.08** (8.6)	**1.83** (8.0)	**1.72** (7.2)
Total oilseeds	**1.20** (7.9)	**1.10** (7.6)	**1.59** (10.4)	**1.70** (10.9)	**1.93** (12.5)	**2.28** (14.3)	**1.52** (14.5)	**2.64** (15.3)	**3.06** (16.7)

Note : Figures in parantheis represent the percentage irrigated area to total area under the crop.

Table 8

Progress Of Selected Physical Agricultural Development Programmes

Programme	Unit	1970-71	1975-76	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
High yielding varieties	Million hect.										
Paddy	"	5.59	12.44	16.88	15.99	18.23	18.89	18.84	21.74	22.78	23.80
Wheat	"	6.48	13.46	15.89	15.03	16.10	15.75	17.84	19.39	19.09	19.72
Maize	"	0.46	1.13	1.35	1.35	1.60	1.53	1.72	1.91	2.03	2.22
Jowar	"	0.60	1.96	3.07	3.05	3.50	3.68	4.37	5.28	5.07	4.88
Bajra	"	2.05	2.90	2.94	2.96	3.64	1.57	4.71	5.42	5.17	4.58
Total HYP	"	15.30	31.89	40.13	38.38	43.07	46.49	47.48	53.74	54.14	55.20
Irrigated Area	"	38.60	45.30	50.60	52.60	54.10	56.00	58.10	58.60	60.50	62.20
Consumption of chemical fertilizers	Million tonnes	2.18	2.89	5.12	5.26	5.52	6.06	6.39	7.71	8.21	8.74

Table 9

All-India Compound Growth Rates Of Area, Production And Yield Of Principal Crops In India During 1949-50 To 1985-86, 1949-50 To 1964-65 And 1967-68 To 1985-86

(in per cent per annum)

Crop	1949-50 to 1985-86			1949-50 to 1964-65			1967-68 to 1985-86		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
Rice	1.00	2.52	1.60	1.33	3.49	2.13	0.85	2.54	1.92
Wheat	2.73	6.00	3.18	2.68	3.99	1.27	2.41	5.64	3.15
Jowar	-0.20	1.30	1.50	0.99	2.50	1.50	-0.69	1.65	2.36
Maize	1.72	2.57	0.84	2.66	3.87	1.18	-0.07	0.98	1.06
Bajra	0.23	1.87	1.65	1.08	2.34	1.24	-0.65	0.19	0.85
Total cereals	**0.79**	**2.98**	**1.85**	**1.30**	**3.24**	**1.68**	**0.31**	**2.97**	**2.21**
Total pulses	**0.32**	**0.32**	**0.17**	**1.90**	**1.39**	**-0.22**	**0.44**	**0.65**	**0.29**
Total foodgrains	**0.59**	**2.64**	**1.73**	**1.41**	**2.93**	**1.43**	**0.34**	**2.74**	**2.30**
Total Oilseeds	**0.96**	**2.00**	**0.71**	**2.69**	**3.11**	**0.20**	**0.23**	**1.65**	**1.28**

Table 10

Trend In Production Of Foodgrains

Year	Production (Million Tonnes		
	Cereals	Pulses	Oilseeds
1950-51	45.81	9.20	4.98
1960-61	69.59	12.73	6.90
1970-71	96.61	11.28	9.28
1980-81	118.96	10.62	9.30
1983-84	139.20	12.30	12.80
1985-86	143.16	12.96	13.00

Table 11

Area, Production & Productivity Of Rice

Year	Area ('000 Ha)	Production ('000 tonne)	Productivity (kg/Ha)
1950-51	30520	22058	723
1960-61	34128	34574	1013
1970-71	37432	42448	1134
1980-81	40152	53632	1336
1985-86	40912	64153	1568

Table 12

Area, Production & Productivity Of Wheat

Year	Area ('000 Ha)	Production ('000 tonne)	Productivity (kg/Ha)
1950-51	NA	6822	NA
1960-61	12927	10997	851
1970-71	17892	26410	1476
1980-81	22279	36313	1630
1985-86	23074	46885	2032

Table 14 a

Fertilizers : Production, Imports And Subsidies

Year	Production (000 tonnes)	Imports (000 tonnes)	Subsidies (Rs. crores)		
			On imported fertilizers	On domestic production	Total
1979-80	2983	2005	282	321	603
1980-81	3005	2759	335	170	505
1981-82	4093	2011	100	275	375
1982-83	4404	1132	55	550	605
1983-84	4533	1355	142	900	1042
1984-85	5181	3624	727	1200	1927
1985-86	5756	3399	324	1600	1924
1986-87*	6950	2500	233	1700	1933

* Anticipated

Table 14b

Development Of Irrigation Potential And Its Utilisation

Year	Major&medium schemes		Minor schemes		All schemes	
	Potential	Utilisation	Potential	Utilisation	Potential	Utilisation
1979-80	26.6	22.6	30.0	30.0	56.6	52.6
1980-81	27.3	22.7	31.4	30.4	58.7	54.1
1981-82	28.2	23.2	32.8	32.8	61.0	56.0
1982-83	29.1	24.0	34.2	34.2	63.3	58.1
1983-84	30.0	24.6	35.6	34.0	65.6	58.6
1984-85	30.1	25.33	37.52	35.25	67.53	60.58
1985-86#	30.57	25.84	39.18	36.43	69.75	62.27
1986-87*	31.26	26.42	40.91	37.69	72.17	64.11
Ultimate potential	58.5		55.0		113.5	

#anticipated
*target

Table 16

Potential And Average Yield For Different Pulses

	Poten-tial yield	Ave-rage yield	Indices of per-formance gap	Poten-tial yield	Ave-rage yield	Indices of per-formance gap	Poten-tial yield	Ave-rage yield	Indices of per-formance gap	Poten-tial yield	Ave-rage yield	Indices of per-formance gap
Andhra Pradesh	1200	270	77.00	-	-	-	863	263	69.53	1250	422	66.24
Bihar	2400	651	72.88	-	-	-	625	429	31.36	1000	436	56.40
Haryana	2650	818	69.10	2650	924	44.00	714	520	27.17	-	-	-
Karnataka	3750	490	86.93	-	-	-	-	-	-	-	-	-
Madhya Pradesh	1305	531	70.58	-	-	-	-	-	-	-	-	-
Maharashtra	1067	350	67.07	-	-	-	902	242	74.85	950	298	69.59
Orissa	1200	463	61.00	-	-	-	600	472	21.33	800	594	25.75
Punjab	-	-	-	-	-	-	842	520	19.00	-	-	-
Rajasthan	2100	716	65.90	1000	281	71.90	1193	154	87.10	-	-	-
Tamilnadu	-	-	-	-	-	-	-	-	-	594	328	44.78
Uttar Pradesh	2000	686	72.56	2075	1745	15.90	1082	303	72.00	-	-	-
West Bengal	-	-	-	-	-	-	821	523	36.30	-	-	-
All India	1570	638	59.37	1037	696	32.99	634	319	49.70	875	312	64.35

Source : Agric. Situat India, April, 1986, pp.25

Table 16a

State-wise Pulse Production During The Year 1983-84

(Production '000 tonnes)

States	Gram	Tur	Black gram	Green gram	Horse gram	Lentil	Peas	Khesari	Moth bean	Others	Total
Andhra Pradesh	23.0	73.5	132.1	221.4	76.3	-	-	-	-	6.4	532.7
Assam	2.0	7.7	-	-	-	-	-	-	-	41.0	50.7
Bihar	141.3	94.5	46.8	68.9	34.8	67.1	19.2	189.3	-	10.0	702.2
Gujarat	117.4	205.3	29.9	132.8	-	-	-	-	44.3	29.0	558.7
Haryana	315.0	16.5	6.2	7.0	-	9.4	4.1	-	0.5	14.3	373.0
Himachal Pradesh	1.0	-	3.0	-	0.8	-	-	-	0.1	7.8	12.7
Jammu & Kashmir	0.4	-	9.3	5.1	0.6	0.3	2.0	-	10.7	2.7	31.1
Karnataka	75.0	151.2	16.4	63.0	258.2	-	-	-	-	30.5	594.3
Kerala	-	0.1	1.8	1.4	12.5	-	4.5	-	-	1.1	21.4
Madhya Pradesh	1455.1	474.5	218.0	74.1	58.1	138.9	39.5	222.6	-	4.1	2685.0
Maharashtra	211.9	487.0	186.7	170.3	94.5	4.7	4.8	26.0	45.8	26.1	1257.7
Manipur	0.1	-	-	-	-	-	-	-	-	1.5	1.6
Meghalaya	0.1	1.0	-	-	-	-	-	-	-	1.0	2.1
Nagaland	-	-	-	-	-	-	-	-	-	1.9	1.9
Orissa	24.3	87.3	225.8	376.0	155.2	-	-	-	-	131.5	1000.1
Punjab	57.0	35.7	7.1	26.0	-	6.5	3.0	-	1.1	0.2	136.6
Rajasthan	1088.9	14.3	86.9	92.8	-	12.4	11.2	-	302.4	50.2	1659.0

..contd..

Table 17

Area Under Oilseeds In India
(Million hectares)

Year	Kharif	Rabi	Total
1970-71	10.80	5.84	16.64
1975-76	10.25	6.67	16.92
1980-81	10.17	7.43	17.60
1985-86	11.47	7.40	18.87

Table 18

Production Of Oilseeds In India
(Million tonnes)

Year	Kharif	Rabi	Total
1970-71	7.01	2.62	9.63
1975-76	7.12	3.49	10.61
1980-81	5.00	4.37	9.37
1985-86	6.24	4.91	11.15

Table 19

All-India Area, Production And Yield Of Nine Oilseeds

Year	Area (ml. hectares)	Production (ml. tonnes)	Yield (kgs./ hectare)	Percentage coverage under irrigation)
1978-79	17.71	10.10	570	10.9
1979-80	16.94	8.74	516	12.5
1980-81	17.60	9.37	532	14.3
1981-82	18.91	12.08	639	15.2
1982-83	17.76	10.00	563	15.3
1983-84	18.69	12.69	679	16.7
1984-85	18.92	12.95	684	-
1985-86	18.87	11.15	591	-

Table 20

Compound Growth Rate Of Area, Production And Yield Of Oilseeds During 1967-68 To 1983-84

(Percent/annum)

State	Groundnut			Rape & Mustard			Safflower			Sesame			Soyabean			Total oilseeds		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
A.P.	0.2[illegible]	1.18	[illegible]				3.14	0.61	-	-2.88	-3.22	-1.04	-			-0.16	0.81	1.10
Assam	-	-	-	4.67	5.04	0.97	-	-	-	-	-	-	-	-	-	4.64	4.93	0.08
Bihar	-	-	-	-0.25	-0.28	-1.05	-	-	-	-	-	-	-	-	-	1.44	1.10	-0.22
Gujarat	1.30	3.[illegible]	2.0[illegible]	13.79	19.09	4.11	-	-	-	-	-	-	-	-	-	2.06	5.31	3.18
Haryana	-	-	-	2.50	4.62	2.13	-	-	-	-	-	-	-	-	-	1.66	3.99	1.97
H.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.32	0.76	0.50
J & K	-	-	-	4.48	8.48	4.74	-	-	-	-	-	-	-	-	-	2.13	6.34	1.59
Karnataka	0.20	0.33	3.01	-	-	-	1.26	1.21	9.28	4.51	5.27	0.[illegible]	-	-	-	2.46	1.69	0.22
Kerala	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.24	-4.59	-4.89
M.P.	-2.40	-2.55	-0.[illegible]	3.03	6.36	3.40	-	-	-	-3.09	-3.89	-0.93	20.[illegible]	19.[illegible]	-1.43	1.82	3.75	1.73
Mah.	-1.24	0.65	2.64	-	-	-	3.70	10.59	7.11	2.47	2.00	-0.16	-	-	-	3.22	4.19	0.95
Orissa	9.49	7.60	-	7.23	7.67	0.01	-	-	-	6.23	6.45	0.32	-	-	-	8.47	8.41	0.01
Punjab	-7.6[illegible]	-7.[illegible]	-0.71	-1.51	0.68	-1.97	-	-	-	-	-	-	-	-	-	-4.62	-5.23	-0.43
Raj.	-1.57	0.2[illegible]	0.73	7.16	10.75	3.17	-	-	-	-2.43	-0.63	1.[illegible]	-	-	-	1.75	5.32	4.39
T.N.	0.05	-0.64	0.33	-	-	-	-	-	-	0.79	0.84	-0.34	-	-	-	0.20	0.29	-1.52
U.P.	-2.59	-3.7[illegible]	0.[illegible]	-0.34	-0.06	-0.78	-	-	-	-1.65	-2.77	-0.07	14.11	14.01	-0.07	-1.15	-[illegible]	-0.61
W.B.	-	-	-	2.54	6.57	3.82	-	-	-	-	-	-	-	-	-	5.70	9.2[illegible]	3.55
All India	0.03	1.31	1.2[illegible]	1.55	2.91	1.54	2.82	9.92	7.56	-0.31	1.00	1.57	15.67	16.63	0.68	1.11	2.42	1.16

Source : Agric.Situat India, Aug.1986

(Production '000 tonnes)

States	Gram	Tur	Black gram	Green gram	Horse gram	Lentil	Peas	Khesari	Moth bean	Others	Total
Sikkim	-	-	-	-	-	-	-	-	-	7.0	7.0
Tamil Nadu	7.0	69.7	70.3	30.1	63.0	-	-	-	-	14.6	254.7
Tripura	1.2	0.3	0.5	0.2	-	0.2	0.2	-	-	0.9	2.5
Uttar Pradesh	1177.8	690.1	46.2	74.0	-	219.0	274.7	-	0.3	-	2482.1
West Bengal	56.7	30.3	57.9	8.5	3.0	42.4	1.0	43.6	-	1.4	244.8
Andaman & Nicobar Islands	-	-	-	-	-	-	-	-	-	0.3	0.3
Arunachal Pradesh	-	-	-	-	-	-	-	-	-	-	-
Dadra & Nagar Haveli	0.1	1.0	1.3	-	-	-	-	-	-	0.3	2.7
Delhi	0.8	-	-	-	-	-	-	-	-	0.6	1.4
Goa, Daman & Diu	-	-	-	-	-	-	-	-	-	-	-
Mizoram	-	-	-	-	-	-	-	-	-	0.7	0.7
Pondicherry	-	-	0.7	0.4	-	-	-	-	-	-	1.1
Total	1754.0	2440.0	1146.9	1352.0	757.1	531.2	364.2	481.5	405.2	301.0	12618.1

Table 23

Distribution Of Certified/Quality Seeds

Year	Lakh quintals	Percentage increase over the preceeding year
1980-81	25.01	-
1981-82	28.91	19.2
1982-83	42.06	41.1
1983-84	44.97	6.9
1984-85	48.46	7.8
1985-86 (likely achievement)	55.01	13.5

Table 24

Offtake Of Fertilizers

(Lakh tonnes of nutrients)

Year	Nitro-genous	Phosphatic	Potassic	Total NPK	Percentage increase*
1979-80	35.0	11.5	6.1	52.6	2.7
1980-81	36.8	12.1	6.2	55.2	4.9
1981-82	40.7	13.2	6.7	60.6	9.9
1982-83	42.2	14.4	7.3	63.9	5.3
1983-84	52.1	17.8	7.7	77.1	20.7
1984-85	54.9	18.8	8.4	82.1	6.5
1985-86	58.2	20.7	8.5	87.4	6.4
1986-87 (target)	63.0	23.0	9.0	95.0	8.7

* In total consumption over the preceeding year

Table 25

Seasonwise Area, Production And Yield Of Oilseeds

	1970-71	1975-76	1980-81	1985-86
Area (ml hectares)				
Kharif	10.80	10.25	10.17	11.47
	(65.0)	(60.6)	(57.8)	(60.8)
Rabi	5.84	6.67	7.43	7.40
	(35.0)	(39.4)	(42.2)	(39.2)
Total Area	16.64	16.92	17.60	18.87
Production (ml. tonnes)				
Kharif	7.01	7.12	5.00	6.24
	(72.8)	(67.1)	(53.4)	(56.0)
Rabi	2.62	3.49	4.37	4.91
	(27.2)	(32.9)	(46.6)	(44.0)
Total Production	9.63	10.61	9.37	11.15
Yield per hectare (kgs)				
Kharif	649	695	492	545
Rabi	449	522	588	663
Total Yield	579	627	532	591

(Figures in brackets indicate the percentage to total)

Table 26

Seventh Plan Production Targets Of Oilseeds
Crop-wise (1986-1990)

Sl. No.	Crop	Base year 1984-85	Target (lakhs tonnes) 1986-87	1987-88	1988-89	1989-90	Per-cent
1.	Groundnut	67.44	76.07	80.95	86.62	92.80	6.5
2.	Rapeseed-Mustard	30.30	33.72	35.84	38.35	1.10	6.5
3.	Soyabean	9.34	11.32	12.05	12.89	13.82	8.0
4.	Sesamum	5.25	6.10	6.49	6.94	7.43	7.0
5.	Safflower	4.97	5.25	5.58	5.97	6.40	6.0
6.	Sunflowe	3.65	4.36	4.65	4.98	5.33	8.0
7.	Niger	1.47	1.58	1.68	1.80	1.93	5.5
8.	Linseed	3.88	4.37	4.65	4.98	5.33	6.5
9.	Castor	4.69	4.80	5.11	5.47	5.86	4.5

Table 26a

Estimates Of Indigenous Supply Of Vegetable Oils

Particulars	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Groundnut oil	14.25	15.90	11.50	14.80	12.00	40.75	13.89
Mustard oil	6.27	7.30	6.90	7.50	7.50	8.05	7.45
Sesamum oil	1.32	1.50	1.70	1.40	1.50	1.82	1.49
Coconut oil	1.80	1.80	1.50	1.30	1.30	1.80	1.80
W. Cottonseed oil	2.20	2.40	2.50	2.50	2.50	2.70	2.80
Safflower oil	0.80	1.00	0.50	1.00	0.60	1.00	1.13
Niger oil	0.33	0.35	0.30	0.30	0.50	0.34	0.36
Soyabean oil	0.50	0.70	0.70	0.90	1.00	1.40	1.54
Sunflower oil	0.23	0.45	0.80	1.00	1.20	0.85	1.24
Castor oil	0.80	1.18	1.20	1.50	1.60	1.52	1.44
Linseed oil	1.24	1.32	1.10	1.40	1.20	1.41	1.41
Ricebran oil	1.30	1.40	1.40	1.80	2.30	2.80	2.50
Other minor oils	1.45	2.16	1.80	1.80	1.80	2.20	2.30
	29.59	37.52	31.30	37.20	35.00	36.64	39.35

Table 26b

Imports Of Edible Oils Into India
(1970-71 to 1985-86)

Year	Edible oil imports
	(Rs. crore)
1970-71	23.1
1975-76	14.2
1980-81	682.9
1981-82	625.3
1982-83	383.9
1983-84	727.5
1984-85	921.1
1985-86	641.31

Source : Economic Survey, 1986-87

Table 27

Relation Between Growth Rate And Population

Rating	Annual rate of growth (%)	Number of years required for the population to double in size
Stationary population	No growth	
Slow growth	Less than 0.5	More than 139 years
Moderate growth	0.5 to 1.0	139-70 years
Rapid growth	1.0 to 1.5	70-47 years
Very rapid growth	1.5 to 2.0	47-35 years
Explosive growth	2.0 to 2.5	35-28 years
-do-	2.5 to 3.0	28-23 years
-do-	3.0 to 3.5	23-20 years
-do-	3.5 to 4.0	20-18 years

Source : Principles of Demography (1969) - John Wiley

Table 28

Population Status Of India

Year	Population (million)	Decadal growth rate	
		Absolute (million)	Percentage
1901	238.4	-	-
1911	252.0	+13.7	+5.75
1921	251.3	-0.8	-0.31
1931	279.0	+27.7	+11.0
1941	318.7	+39.7	+14.22
1951	361.0	+42.4	+13.31
1961	439.2	+78.0	+21.51
1971	548.2	+108.9	+24.80
1981	685.2	+137.0	+25.00
1986	762.0	+77.0	+11.00

Table 28a

Selected Population Projection For India, 1980-81 to 2000-2001

(million)

Sources and assumptions	1971/ 1975/ 1976	1980/ 1981	1985/ 1986	1990/ 1991	2000/ 2001
1. Registrar General (1984)	**1971**	**1981**	**1986**	**1991**	**2001**
(a) High	548	685	758	843	1053
(b) Medium	548	685	758	836	991
(c) Low	548	685	758	833	959
2. Expert Committee (1979)	**1971**	**1981**	**1986**	**1991**	**-**
(a) Slow fertility decline	547	672	735	799	-
(b) Medium fertility decline	547	671	729	778	-
(c) Fast fertility decline	547	663	713	754	-
3. World Bank (July, 1979)	**1975**	**1980**	**1985**	**1990**	**2000**
NRR=1 by 2020 A.D.	608	674	745	821	973
4. U.S. Bureau of the Census (January, 1979)	**1975**	**1980**	**1985**	**1990**	**2000**
(a) High series	618	694	786	894	1142
(b) Medium series	618	690	764	844	1021
(c) Low series	618	687	757	828	974
5. United Nations (August, 1979)	**1985**	**1980**	**1985**	**1990**	**2000**
(a) High varient	619	699	792	892	1105
(b) Medium varient	619	694	776	862	1039
(c) Low varient	619	690	765	840	984
6. R.H. Cassen (1978)	**1976**	**1981**	**1986**	**1991**	**2001**
(a) F2M1 (low fertility-mortality decline)	621	688	758	829	970
(b) F3M2 (medium fertility and low mortality decline)	619	682	745	808	922
(c) F3M1 5 (medium-fast fertility & mortality decline)	618	678	736	792	887

Source : Journal of Family Welfare, Vol.XXXIII (4), June 87, p.36.

Table 29

Population Projections Under Different Models

Year	Models					
	E1	E2	L1	L2	G1	G2
	(in million numbers)					
1985	765.5	721.6	755.2	720.7	746.2	714.5
1990	868.3	792.1	864.0	789.7	839.0	774.6
1995	1004.3	869.6	995.0	865.0	945.2	838.0
2000	1170.9	954.6	1153.0	947.0	1066.0	904.7
2005	1376.0	1048.0	1343.0	1036.1	1203.0	974.7
2010	1629.6	1150.4	1573.0	1133.0	1357.0	1048.0

E1 and E2 = exponential fit on squared time and time
L1 and L2 = Pearl fit on squared time and time
G1 and G2 = Gompertz fit on squared time and time

Table 30

Year Of Doubling Of Population Based On Above Models

Base year	Models					
	E1	E2	L1	L2	G1	G2
	(in million numbers)					
1981	2005	2019	2006	2020	2011	2028
1985	2008	2023	2009	2024	2014	2034

Table 30a

Distribution Of Population By Age Group Projection Under Different Models

(Percentage of total population)

Year	Model											
	L1			L2			G1			G2		
	0-14	15-59	60+	0-14	15-59	60+	0-14	15-59	60+	0-14	15-59	60+
1985	36.0	58.1	5.81	36.6	55.2	5.74	35.5	59.0	5.72	37.0	57.0	5.88
1990	34.7	60.0	5.75	35.0	59.3	5.68	33.8	60.6	5.59	36.4	57.8	5.88
1995	33.3	61.0	5.70	34.0	60.3	5.62	32.0	62.6	5.44	35.8	58.4	5.88
2000	32.0	62.4	5.63	33.1	61.4	5.55	30.0	64.7	5.27	35.2	59.0	5.89
2005	30.6	62.8	5.58	32.1	62.4	5.50	28.0	67.0	5.07	34.6	59.5	5.89
2010	29.3	65.2	5.54	31.2	63.3	5.44	26.0	69.0	4.97	34.1	60.0	5.92

Table 31

Equations Derived For Different Growth Models Used For Population Projection

Model	Equation
E1	Population = 242.62 exp [0.00015740$8$(years-1900)^2] (n=7, r=0.999)
	OR
	Population = 242.62[1+0.015742/100]$^{(year-1900)^2}$ (n=7, r=0.999)
E2	Population = 147.73 exp [0.018659(year-1900)] (n=7, r=0.998)
	OR
	Population = 147.72[1+1.8834/100]$^{(year-1900)}$ (n=7, r=0.998)
L1	Population = 15000/[1+61.087 exp(-0.0001626(year-1900)^2)] (n=7, r=-0.999)
L2	Population = 15000/[1+101.9306 exp(-0.0192695(year-1900))] (n=7, r=-0.993)
G1	Population= 15000 exp[-4.1718 exp(-0.000045601(year-1900)^2)] (n=7, r=-1.000)
G2	Population = 15000 exp[-4.8092 exp(-0.00537976(year-1900))] (n=7, r=-0.989)

The population is in millions

Table 32

Energy Coefficients Derived From Different Models

Year	Model			
	L1	L2	G1	G2
1985	0.8270	0.8271	0.8283	0.8248
1990	0.8300	0.8294	0.8322	0.8262
1995	0.8330	0.8396	0.8353	0.8276
2000	0.8360	0.8337	0.8407	0.8288
2005	0.8390	0.8358	0.8452	0.8299
2010	0.8419	0.8378	0.8498	0.8310

Table 33

Weighted Energy Units Derived From Different Models

(in million numbers)

Year	Model			
	L1	L2	G1	G2
1985	624.6	596.1	618.1	589.3
	(655.8)	(625.9)	(649.0)	(618.8)
1990	717.1	655.0	698.3	640.0
	(753.0)	(687.7)	(733.2)	(672.0)
1995	828.8	719.3	790.5	693.5
	(870.0)	(755.3)	(830.0)	(728.2)
2000	963.7	789.5	896.2	749.8
	(1011.9)	(829.0)	(941.0)	(787.3)
2005	1126.9	866.0	1016.6	808.9
	(1183.3)	(909.3)	(1067.4)	(849.4)
2010	1324.1	949.3	1153.2	870.9
	(1390.4)	(996.7)	(1210.9)	(914.4)

Figures in parenthesis are at 5% leverage on standard weight

Table 34

A. Food Raw Materials Used And Their Proximate Composition For L.P. Model

Item	Proximate Composition	
	Protein (%)	Energy (KCal/100g)
Rice	6.6	345
Wheat	10.0	340
Pulses	21.8	347
Millets	11.0	343
Ragi	7.3	328
Flesh	17.2	153
Potato	1.36	82
Tapioca	0.70	157
Milk	3.2	67
Fat	-	900
Sugar	-	398
Coconut	4.5	444

Flesh includes meat, fish and eggs

B. Constraints :

1. Minimum energy : 2400 KCal
2. Minimum protein : 55g
3. Milk fixed at 50g
4. Approximate energy from fats/oils : 20%
5. Energy from cereals < 60% of the total
6. When millets are included energy derived from
   millets : cereals = 1:2
   with a maximum of 60% total energy
7. When flesh is included minimum fixed at 30g

Table 35

Diet Composition Of Different States

State	Rice	Rice+ Ragi	Rice+ Millet	Rice+ Ragi+ Flesh	Rice+ Millet +Flesh	Rice+ Potato	Rice+ Flesh	Rice+ Tap.+ Flesh	Wheat	Wheat+ Millet	Wheat+ Millet+ Flesh	Wheat+ Flesh	Wheat+ Potato	Rice+ wheat		
														2:1	1:1	1:2
A.P	20.0	10.0	10.0	-	10.0	-	50.0	-	-	-	-	-	-	-	-	-
Assam	-	-	-	-	90.0	-	10.0	-	-	-	-	-	-	-	-	-
Bihar	10.0	-	-	-	-	10.0	20.0	-	10.0	-	-	10.0	-	-	40.0	-
Guj.	-	-	30.0	-	-	-	-	-	-	-	-	10.0	40.0	-	20.0	-
H.P.	-	-	-	-	-	-	-	-	-	25.0	-	25.0	-	-	-	50.0
J&K	-	-	-	-	25.0	10.0	60.0	-	-	-	-	50.0	-	-	-	-
Karnataka	10.0	-	10.0	40.0	20.0	-	10.0	-	-	-	-	-	-	10.0	-	-
Kerala	-	-	-	-	-	-	30.0	70.0	-	-	-	-	-	-	-	-
M.P.	-	-	-	-	-	-	-	-	10.0	10.0	-	50.0	20.0	-	10.0	-
Mah.	-	-	-	-	20.0	10.0	30.0	-	-	-	-	20.0	10.0	10.0	-	-
Orissa	20.0	30.0	-	-	40.0	-	10.0	-	-	-	-	-	-	-	-	-
Punjab+ Haryana	-	-	-	-	-	-	-	-	5.0	5.0	-	70.0	20.0	-	-	-
Raj.	-	-	75.0	-	-	-	-	-	-	-	-	20.0	-	-	-	5.0
T.N.	30.0	-	-	10.0	-	-	60.0	-	-	-	-	-	-	-	-	-
U.P.	-	-	-	-	-	-	-	-	10.0	20.0	-	30.0	-	40.0	-	-
W.B.	-	-	-	-	-	10.0	90.0	-	-	-	-	-	-	-	-	-
Rest	-	-	-	-	-	90.0	10.0	-	-	-	-	-	-	-	-	-

Flesh includes meat, fish and poultry products
Tap. = Tapioca

Table 36

Least Cost Diet Formulation Derived From LP Model

A. Rice based diet formulation :

(in grams per capita/day)

Diet No.	Rice	Ragi	Millets	Wheat	Pulses	Fat	Sugar	Potato	Milk	Flesh	Coconut	Total qty.	Protein (g)	Energy (KCal)	Price (Rs.)
1.	446	-	-	-	110	30	44	-	50	-	-	680	55.02	2399.02	2.91
2.	461	-	-	-	82	30	44	-	50	30	-	697	55.06	2399.51	3.42
3.	332	146	-	-	72	30	44	-	50	30	-	704	55.03	2398.64	3.27
4.	317	146	-	-	100	30	44	-	50	-	-	687	54.98	2398.15	2.77
5.	348	-	140	-	69	30	44	-	50	-	-	681	55.01	2398.85	2.91
6.	363	-	140	-	41	30	44	-	50	30	-	698	55.06	2399.34	3.15
7.	428	-	-	-	111	30	44	73	50	-	-	736	55.04	2400.25	2.96
*8.	325	-	-	-	-	30	56	-	50	135	95	825	55.13	2403.93	5.14#

* includes 134 gms of tapioca

at half the market price of flesh foods the price would be Rs.2.70 per consumption unit

B. Wheat based diet formulations

Diet No.	Wheat	Millets	Pulses	Potato	Fat	Sugar	Milk	Flesh	Total quantity	Protein (g)	Energy (KCal)	Price (Rs.)
1.	425	--	54	--	55	60	50	--	644	55.87	2399.58	2.72
2.	425	--	41	--	55	60	50	30	661	58.20	2400.47	3.25
3.	282	140	42	--	55	60	50	30	659	59.52	2397.94	3.20
..	282	140	56	--	55	60	50	--	643	57.41	2400.62	2.67
5.	424	--	44	100	30	106	50	--	754	54.95	2401.66	2.50

C. Rice + wheat based diet formulation :

Diet No.	Rice	Wheat	Pulses	Fat	Sugar	Milk	Total quantity	Protein (g)	Energy (KCal)	Price (Rs.)
* 1.	139	282	73	55	45	50	644	54.89	2399.25	2.87
** 2.	278	141	96	55	25	50	645	54.98	2439.42	3.03
*** 3.	209	212	85	55	35	50	646	55.12	2404.6	2.95

* Rice : Wheat = 1:2 (energy)
** Rice : Wheat = 2:1 (energy)
*** Rice : Wheat = 1.1 (energy)

Table 37

Projected Demand For Rice At Consumer Level

(in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	60.0	57.4	57.0	57.0
	(63.0)	(60.0)	(62.0)	(60.0)
1990	69.0	63.0	67.0	62.0
	(72.5)	(66.0)	(71.0)	(65.0)
1995	79.0	66.3	76.0	65.0
	(84.0)	(73.0)	(80.0)	(70.0)
2000	93.0	76.0	86.0	72.0
	(97.5)	(80.0)	(90.0)	(76.0)
2005	108.0	83.6	98.0	78.0
	(114.0)	(88.0)	(103.0)	(82.0)
2010	127.6	92.0	111.0	84.0
	(134.0)	(96.0)	(117.0)	(88.0)

Figures in parenthesis are at 5% leverage on standard rate

Table 38

Projected Demand For Rice At Farm Level*

Year	Model			
	L1	L2	G1	G2
1985	69.3	66.0	68.2	66.0
1990	80.0	73.0	78.0	71.5
1995	92.4	80.0	88.0	77.0
2000	107.0	92.4	99.0	84.0
2005	125.0	97.0	113.0	91.0
2010	147.0	106.0	129.0	97.0

*@ 10% leverage on feed, seed and wastage and 5% leverage on standard weight

Table 39

Projected Demand For Wheat At Consumer Level

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	33.0 (35.0)	32.0 (33.0)	33.0 (34.0)	31.0 (33.0)
1990	38.0 (40.0)	35.0 (36.4)	37.0 (39.0)	34.0 (35.6)
1995	44.0 (46.0)	38.0 (40.0)	43.0 (44.0)	36.0 (39.0)
2000	51.0 (54.0)	42.0 (44.0)	47.0 (50.0)	40.0 (42.0)
2005	60.0 (69.0)	46.0 (48.0)	54.0 (56.0)	43.0 (45.0)
2010	70.0 (74.0)	50.0 (53.0)	61.0 (64.0)	46.0 (48.0)

Figures in parenthesis are at 5% leverage on standard weight

Table 40

Projected Demand For Wheat At Farm Level*

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	39.0	37.0	38.0	37.0
1990	45.0	41.0	44.0	40.0
1995	51.5	45.0	49.0	44.0
2000	60.5	49.0	56.0	47.0
2005	77.3	54.0	63.0	50.4
2010	83.0	59.4	72.0	54.0

*@ 12% leverage for seed, feed and wastage and 5% on standard weight

Table 41

Projected Demand For Ragi At Consumer Level

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	1.6	1.5	1.6	1.5
	(1.7)	(1.6)	(1.6)	(1.6)
1990	1.8	1.7	1.8	1.6
	(1.9)	(1.8)	(1.7)	(1.7)
1995	2.0	1.9	2.0	1.7
	(2.2)	(2.0)	(2.1)	(1.9)
2000	2.5	2.0	2.3	1.9
	(2.6)	(2.1)	(2.4)	(2.0)
2005	2.9	2.2	2.6	2.1
	(3.0)	(2.3)	(2.7)	(2.2)
2010	3.4	2.4	3.0	2.2
	(3.6)	(2.6)	(3.1)	(2.3)

Figures in parenthesis @ 5% leverage on standard weight

Table 42

Projected Demand For Ragi At Farm Level*

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	1.9	1.8	1.8	1.8
1990	2.1	2.0	2.1	1.9
1995	2.5	2.3	2.4	2.1
2000	2.9	2.4	2.7	2.3
2005	3.4	2.6	3.0	2.5
2010	4.1	2.9	3.5	2.6

*@ 12.5% leverage for feed, seed and wastage and 5% for standard weight

Table 43

Projected Demand For Millets At Consumer Level

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	6.7 (7.0)	6.4 (6.7)	6.7 (7.0)	6.4 (6.7)
1990	7.7 (8.0)	7.0 (7.4)	7.5 (8.0)	7.0 (7.4)
1995	8.9 (9.3)	7.8 (8.1)	9.5 (10.0)	7.7 (8.0)
2000	10.3 (11.0)	8.5 (9.0)	9.6 (10.0)	8.5 (8.7)
2005	12.0 (13.0)	9.4 (10.0)	11.0 (11.7)	9.3 (9.8)
2010	14.2 (15.0)	10.3 (11.0)	12.4 (13.0)	10.2 (10.7)

Figures in parenthesis @ 5% leverage on standard weight

Table 44

Projected Demand For Millets At Farm Level*

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	8.0	7.7	8.0	7.7
1990	9.3	8.5	9.2	8.5
1995	10.7	9.3	11.5	9.2
2000	13.0	10.3	11.5	10.3
2005	15.0	11.5	13.2	11.3
2010	17.3	13.0	15.0	12.3

@ 15% leverage on feed, seed and wastage and 5% on standard weight

Table 45

Projected Demand For Pulses At Consumer Level

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	15.4	14.8	15.3	14.6
	(16.2)	(15.5)	(16.2)	(15.3)
1990	18.0	16.2	17.0	16.0
	(19.0)	(17.0)	(18.0)	(17.0)
1995	20.5	18.0	19.5	17.0
	(21.5)	(18.8)	(20.5)	(18.0)
2000	24.0	19.7	22.0	18.5
	(25.0)	(21.0)	(23.0)	(19.5)
2005	28.0	22.0	25.0	20.0
	(29.0)	(23.0)	(26.0)	(21.0)
2010	33.0	24.0	28.5	21.5
	(34.0)	(25.0)	(30.0)	(23.0)

Figures in parenthesis is at 5% leverage on standard weight

Table 46

Projected Demand For Pulses At Farm Level*

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	18.2	17.5	18.2	17.0
1990	21.4	19.0	20.2	19.0
1995	24.0	21.0	23.0	20.2
2000	28.0	24.0	26.0	22.0
2005	33.0	26.0	29.0	24.0
2010	48.0	28.0	34.0	26.0

* @ 12.5% leverage on feed, seed and wastage and 5% on standard weight

Table 47

Projected Demand For Fat At Consumer Level

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	9.0	8.6	9.0	8.5
	(9.5)	(9.0)	(9.4)	(9.0)
1990	10.4	9.5	10.0	9.3
	(11.0)	(10.0)	(10.6)	(9.7)
1995	12.0	10.5	11.4	9.7
	(12.6)	(11.0)	(12.0)	(10.5)
2000	14.0	11.5	13.0	11.0
	(14.6)	(12.0)	(13.0)	(11.4)
2005	16.3	13.0	15.0	12.0
	(17.0)	(13.0)	(15.4)	(12.3)
2010	19.0	14.0	17.0	12.6
	(20.0)	(15.0)	(17.5)	(13.2)

Figures in parenthesis is at 5% leverage on standard weight

Table 48

Projected Demand For Fat In Terms Of Oilseeds At Farm Level*

(Quantity in million tonnes)

Year	Model			
	L1	L2	G1	G2
1985	30.0	29.0	29.0	28.0
1990	34.5	31.0	33.0	30.0
1995	39.0	34.5	38.0	33.0
2000	46.0	38.0	43.0	36.0
2005	53.0	41.0	48.0	38.0
2010	63.0	46.0	54.0	41.0

* @ 15% leverage on seed and wastage and 5% on standard weight

Table 49

Projected Production Of Rice Under Different Models

(Quantity in million tonnes)

Year	Model					
	L1	L2	L3	G1	G2	G3
1985	62.0	62.0	61.5	61.4	61.3	61.0
1990	70.0	70.0	69.0	69.0	69.0	68.0
1995	79.0	79.0	77.5	77.0	76.4	75.3
2000	89.0	88.4	86.0	85.0	84.4	82.5
2005	100.0	99.0	95.0	94.0	93.0	90.0
2010	112.0	110.6	105.0	103.0	101.0	97.2

L1 and G1 at national potential yield
L2 and G2 at average national demonstration yield
L2 and G3 at average yield of the above two

Table 50

Projected Production Of Wheat Under Different Models

(Quantity in million tonnes)

Year	Model					
	L1	L2	L3	G1	G2	G3
1985	51.0	51.0	51.0	50.0	49.5	49.0
1990	68.0	67.0	63.0	63.0	62.0	61.0
1995	88.0	84.0	77.0	77.0	75.0	72.0
2000	109.0	103.0	91.0	91.0	87.0	82.0
2005	131.0	120.0	105.0	105.0	99.0	91.0
2010	151.0	135.0	119.0	119.0	110.0	99.0

L1 and G1 at national potential yield
L2 and G2 at average national demonstration yield
L2 and G3 at average yield of the above two

Table 51

Projected Production Of Oilseeds Under Different Models

(Quantity in million tonnes)

Year	Model					
	L1	L2	L3	G1	G2	G3
1985	11.0	11.0	11.0	11.0	11.0	11.1
1990	12.2	12.2	12.2	12.2	12.0	12.1
1995	13.5	13.5	13.4	13.4	13.3	13.2
2000	15.0	15.0	14.6	14.6	14.4	14.3
2005	16.4	16.2	16.0	16.0	15.6	15.4
2010	18.0	17.6	17.1	17.1	16.7	16.4

L1 and G1 at national potential yield
L2 and G2 at average national demonstration yield
L2 and G3 at average yield of the above two

Table 52

Projected Demand & Supply Balance For Rice Under High & Low Growth Models

(Quantity in Million tonnes)

Year		Demand	Supply	Balance (S/D)
1990	H	80.0	70.0	-10.0
	L	71.0	68.0	- 3.0
1995	H	92.0	79.0	-13.0
	L	77.0	75.0	- 2.0
2000	H	107.0	89.0	-18.0
	L	84.0	82.0	- 2.0
2005	H	125.0	100.0	-25.0
	L	91.0	90.0	- 1.0
2010	H	147.0	112.0	-35.0
	L	97.0	97.0	Nil

H = under L1 model
L = under G1 model

Table 53

Projected Demand And Supply Balance For Wheat Under High & Low Growth Models

(Quantity in million tonnes)

Year		Demand	Supply	Balance (S/D)
1990	H	45.0	68.0	+23.0
	L	40.0	61.0	+21.0
1995	H	51.0	88.0	+37.0
	L	44.0	72.0	+28.0
2000	H	60.0	109.0	+49.0
	L	47.0	82.0	+35.0
2005	H	77.0	131.0	+54.0
	L	50.0	91.0	+41.0
2010	H	83.0	151.0	+68.0
	L	54.0	99.0	+45.0

H = under L1 model
L = under G1 model

Table 54

Projected Demand & Supply Balance For Millets and Ragi Under High & Low Growth Models

(Quantity in million tonnes)

Year		Demand	
		Millets	Ragi
1990	H	9.3	2.0
	L	8.5	1.9
1995	H	10.7	2.5
	L	9.0	2.1
2000	H	13.0	2.9
	L	10.0	2.3
2005	H	15.0	3.4
	L	11.0	2.5
2010	H	17.0	4.0
	L	12.0	2.6

Even the projected demand at 2010 AD is far less than the present production level in case of millets and only 1.5 million tonnes of additional production required for ragi to meet demand at 2010 AD

Table 55

Projected Demand & Supply Balance For Pulses Under High & Low Growth Models

(Quantity in million tonnes)

Year		Demand	Supply	Balance (S/D)
1990	H	21.0	14.5	-6.5
	L	19.0	13.2	-5.8
1995	H	24.0	16.2	-7.8
	L	20.0	14.0	-6.0
2000	H	28.0	18.0	-10.0
	L	22.0	14.0	-8.0
2005	H	33.0	20.0	-13.0
	L	24.0	14.0	-10.0
2010	H	48.0	23.0	-25.0
	L	26.0	15.0	-11.0

H = under L1 model
L = under G1 model

Table 56

Projected Demand & Supply Balance For Oilseeds Under High & Low Growth Models

(Quantity in million tonnes)

Year		Demand	Supply	Balance (S/D)
1990	H	34.5	12.2	-22.3
	L	30.0	12.2	-17.8
1995	H	39.0	13.5	-25.5
	L	33.0	13.0	-20.0
2000	H	46.0	15.0	-31.0
	L	36.0	14.0	-22.0
2005	H	53.0	16.0	-39.0
	L	38.0	15.0	-23.0
2010	H	63.0	18.0	-45.0
	L	41.0	16.0	-25.0

H = under L1 model
L = under G1 model

Table 57

Additional Requirement At Present Production To Meet Projected Demand By 2010 A.D.

(Quantity in million tonnes)

Item	Present production (1985-86)	Projected demand (2010 A.D.)		Additional requirement	
		High	Low	High	Low
Rice	64.0	147.0	97.0	83.0	33.0
Wheat	47.0	83.0	54.0	36.0	7.0
Millets	22.0	17.0	12.0	Nil	Nil
Ragi	2.5	4.0	2.6	1.6	0.1
Pulses	13.0	48.0	26.0	35.0	13.0
Oilseeds	12.9	63.0	41.0	50.1	28.1